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NOVEMBER, 1850.

CIVIL ENGINEERING.

*A Chapter in the History of Railway Locomotion.**

Continued from page 230.

There was still considerable indecision in the matter on the part of the directors, although considerable partiality was evinced by the major portion of them in favor of the locomotive, provided engines of this class could be built of sufficient power, whilst their weight was kept below that of the existing engines, some seven or eight tons; and in conformation with the railway act, requiring that no smoke should be discharged.

To distinguish accurately what was the cause of this favorable leaning of the directors towards the locomotive system, after the very opposite evidence which they had received, may, perhaps, be deemed a straining of the point; but there is good room for the presumption, that the evidence supplied by Mr. Hackworth, through Mr. Robert Stephenson, in the letter which we have quoted, had considerable influence in determining their choice. No other person had at this period anything like the practical knowledge which he possessed, in reference to the working of railways by both systems, the relative merits of which he had fully tested on the Darlington line.

One of the directors—Mr. Harrison—having given it as his opinion, that the expectancy of a reward, to be offered to the public as an excitement to competition, would have the desired effect, this mode of procedure was at length adopted; and, in April, 1829, they offered a premium of £500 for the best locomotive engine, conformable with certain regulations and conditions. The story of the competition—in which Mr. Hack-

* From the Glasgow Practical Mechanic's Journal, for June, 1850.

worth joined—with the results of the test of the different engines, has been often told.

It is to be regretted that Mr. Hackworth, as an agent of the Stockton and Darlington Company, had not more extended means for the more perfect accomplishment of his designs; and that only such time as could be snatched from their service could be devoted to his own plans. As the Company's means were little more than adequate to the repairs of their own plant of engines, a great part of the work in his trial engine was executed at other establishments—the boiler being made at the Bedlington Iron Works, and the cylinders by Messrs. Stephenson.

The "Sanspareil" had a cylindrical boiler, 6 feet long, and 4 feet 2 inches diameter, one end being flat, and the other hemispherical. The heating surface consisted of a double tube traversing the whole length of the boiler, and returning to the fire-end; the fire-grate and chimney being both at one end of the engine—the fire-grate in one tube, whilst the chimney terminated the other. The tube extended from the boiler to a length of about 3 feet, with a casing of a semicircular form surrounding it at the fire-end, except at the chimney, where this casing extended only 2 feet. With this arrangement a greater extent of heating surface was obtained, than if tubes limited to the boiler's length had been used. The length of the grate-bars was 5 feet, and the diameter of the tube at the fire-end 2 feet, reduced to 15 inches in the return tube, this being also the size of the chimney. The area of the fire-grate was 10 square feet; the area of the surface of water exposed to the radiating heat, or direct action of the fire, being 15·7 square feet; and that acted on by the carried heat, 74½ square feet. She was carried on four wheels, 4 feet 6 inches diameter. The boiler was very imperfect as a piece of workmanship, and considerable leakage resulted. To such an extent were the joints defective, that many of them had copper run in and caulked up to make them steam-tight. Of the cylinders the same may be said—six castings were made before two perfect ones were got. The sixth cylinder had to be substituted at Liverpool, immediately after the contest at Rainhill, the fifth having burst during the competition. The imperfection in this case was in the metal forming the partition between the bore of the cylinder and the port-way or steam pipe along the cylinder side, which had been cast and bored so thin in one part, as to leave less than $\frac{1}{16}$ inch of metal. The consequence was, that the engine had no sooner commenced working than the cylinder burst, when the race had to be run with one perfect cylinder only, whilst the fracture of the other one opened at every stroke a direct communication between the boiler and the chimney. Not only did this mal-adventure render the "Sanspareil's" case hopeless, by a tremendous loss of steam, but as each burst took place when the steam-slide opened the communication with the injured cylinder, a great quantity of fuel was ejected from the fire-grate. It is obvious that, under these circumstances, the "Sanspareil" had little chance against the "Rocket"—Messrs. Stephenson's engine—which was perfect in all its constructive details. As it was, the only superiority of the latter was in her economy of fuel. The trial run, indeed, was not of such a character as fairly to test the two engines—the distance being no more than 1½ miles. The blast-pipe of the "Sanspareil" was fitted to enable her to maintain her

working pressure during a long journey; whilst the "Rocket," unprovided with this appendage, was capable of generating steam nearly as well when at rest as when in action. Thus the latter was enabled to get up a sufficiency of steam for her run previous to starting, and when brought to a stand at the stations regained the steam power lost during the run, which was well performed on so short a distance as 1½ miles. This would not have been the case in the regular journeys of a working line. Such a test, therefore, was practically worthless, in arriving at a due comparison of performance for a line of considerable length, like the Liverpool and Manchester.

Shortly after this trial, Mr. Stephenson being anxious to investigate the "Sanspareil's" blast-pipe, despatched a nocturnal visitant to inspect it and take its dimensions. Our informant on this little bit of finesse is the actual person who made the survey—he is still living. The result of the observation which he made was, that a similar blast-pipe was constructed and fitted to the "Rocket." The actual working efficiency of the "Sanspareil" has been tolerably illustrated in Mr. Armstrong's work on Steam Boilers, where he says that—"The original 'Sanspareil' of Mr. Hackworth, which all but successfully competed for the prize at the opening of the Liverpool and Manchester Railway, may still be seen regularly working on the Bolton and Leigh Railway, apparently not much worse for seven years' constant work, the boiler never having required any essential repair,* while its contemporary rivals, that have escaped the fate of the 'scrap heap,' have been re-made, and mended over and over again since the celebrated race at Rainhill, a fact which goes far to prove that the principle of this engine has not been so very much improved upon, except that it is not so well calculated for burning coke as coal. The 'Sanspareil' may frequently be seen at the Kenyon Junction, waiting for the Bolton trains from Liverpool, and plans of it may be seen in Dr. Lardner's work."

In one point the "Rocket" possessed a feature of eminent superiority, which has since proved to be the main-stay of the modern locomotive—in the small flue-tubes—the invention of Mr. Henry Booth, the talented secretary of the Liverpool and Manchester line, to whom railways owe much of their present practical efficiency.

The extreme lightness of the engines insisted on by the directors led to an objection against the "Sanspareil," on the ground of an excess of weight; but it was forgotten that, although in gross weight she exceeded her rival, yet on neither pair of wheels was there so great a pressure as in the latter. At this time, when each engineer was feeling his way, some curious specimens of locomotive mechanism were turned out. A letter written to Mr. Hackworth, by one of the directors of the Stockton and Darlington line, gives a facetious account of an engine supplied to that line by Messrs. Stephenson:—"I should have been extremely glad to have heard that fair play had been allowed to the different engine-makers who were competitors for the premium; from the very cool reception that a *Timothy* received from Forth street, George showed very plainly that he was much afraid of the Shildon production; and well they might, as they

* Since it was properly repaired immediately after the contest at Liverpool.—Ed. P. M. Journal.

well know that every engine which they have yet sent has had great need of mending. The new one last sent was at work scarcely a week before it was completely condemned, and not fit to be used in its present state. The hand-gear and valve shave no control in working it. When standing without the wagons at Tully's a few days ago, it started by itself when the steam was shut off, and all that Jem Stephenson* could do he could not stop it,—it ran down the branch with such speed that old Jem was crying out for help, every one expecting to see them dashed to atoms; the depôts being quite clear of wagons, this would have been the case, had not the teamers and others thrown blocks in the way, and fortunately threw it off.

"A similar occurrence took place on the following day, in going down to Stockton. As soon as the wagons were unhooked at the top of the run, away goes *Maniac!* defying all the power and skill of her jockey, old Jem, nor could it be stopped until it arrived near the staiths. Had a coach been on the road coming up, its passengers would have been in a most dangerous position. The force-pump is nearly useless, having had, every day it was at work, to fill the boiler with pails at each of the watering places. No fewer than three times the lead plug has melted out. This *Maniac* was a Forth Street production, and at last was obliged to be towed up to the *hospital* by a real Timothy† in front, on six wheels, and actually had twenty-four wagons in the rear as guard. It is now at head quarters at Shildon.

"From what I have heard of the doings with you, it appears that the engine which had *a Booth* as the inventor of the copper pipes in the boiler, was, without either judge or jury, to be the winner."

On Mr. Hackworth's return from Liverpool, he found the "Rocket" lodged in the shed, waiting his arrival; and, as the Company's engineer, he had to put her in the best possible repair. From the defective construction of the hand-gear, and the imperfection of her force-pump, these details had to be completely remodeled.

The next engine which figured conspicuously on the Stockton and Darlington line was the "Globe," which was the first ever designed with a crank axle. She was built from Mr. Hackworth's designs, by Messrs. Stephenson, as the Railway Company's hands were too full to allow of the work being done at their private establishment. The novelties carried out in her were—the crank-axle working by inside cylinders beneath the boiler, and a modification of the hand-gear, whereby the reversing was effected by a single lever—two drivers being placed on the axle, one on each side of the pair of eccentric sheaves. The wheels were four in number, 5 feet diameter, being the largest then in use. A single flue ran straight through the boiler, having the fire-grate in one end. A number of small tubes were also passed transversely through the diameter of the main flue, so as to form a species of spiral, the water being allowed to circulate through them. This arrangement effectively exposed a considerable surface to the action of the heat; and her steam-generating powers were much superior to any other engine of her time, having the same area of heating surface. Still, at this date, a great objection existed

* Brother to the late Mr. George Stephenson.

† "Royal George" Engine.

in the slow circulation of the water through the tubes, and the consequent accumulation of mud in the horizontal tubes, which, forming an incrustation, speedily destroyed them. Another novelty in her construction was the placing a copper globe on the top of the boiler, to serve as a steam-receiving dome—hence arose her name. This engine opened the branch line between Stockton and Middlesbro', a distance of four miles. Her rate was frequently fifty miles per hour.

All constructive innovations are invariably looked upon with distrust by the merely practical man; and when the designs for this first crank-axle engine were laid before Messrs. Stephenson for their execution, an objection was raised by one of the officials of the establishment, that the crank-axle would certainly involve a loss of power, as the efficient length of lever could only be calculated from the inside of the journal to the axle's centre.

In 1830, the increase of traffic on the Stockton and Darlington line, requiring an addition to the working stock of engines, two different modifications were designed by Mr. Hackworth. Both these were six wheelers, spring-mounted, and coupled throughout; the boiler of the first kind being 13 feet long. The flue consisted of a main tube, 9 feet long, by 2 feet 6 inches diameter, in one end of which the fire-grates were inserted. The other end was separated from the boiler by a partition-plate, into which a number of small copper tubes, 4 feet in length, were inserted, for the conveyance of the vapor through the remaining portion of the boiler to the smoke-box, which was at the contrary end to the fire. The cylinders were placed vertically at one end of the boiler, their connecting rods being attached to a crank-shaft directly beneath. This was a plain shaft, with two cranks keyed on its ends at right angles to each other. From these cranks, coupling rods passed to similar cranks on the axles of the whole set of wheels. The slide-valves were actuated by two eccentrics, having a single lever reversing apparatus; the force-pumps being worked by the same eccentrics.

In the second arrangement, the distinctive feature was in the heating surface—the valve-gearing, cylinders, wheels, and connexions being as before, except that the cylinders were mounted on framing projecting six feet from the boiler. The boiler was 10 feet long, by 4 feet 4 inches diameter, and the arrangement of heating surface presented some novelties now much in use in the northern Engligh counties, and termed a "return multitubular fire-tube." It consisted of a main tube, 2 feet 4 inches diameter at the large end, reduced to 2 feet at the opposite end, and 8 feet long. The large end contained the fire-grates, and at the small end a box of a D-shape was placed to receive the heated vapor after its passage through the main tube, conveying it back again through the water by a number of small copper tubes, surrounding the large tube on all sides except the bottom, being inserted in the tube-box at one end, and in the plate forming the end of the boiler at the other. At the fire end a semi-circular box carried the smoke into the chimney. This arrangement proved to be the best of its day for the general traffic of the line, as well in its economy as in its durability, the flues having been repeatedly known to wear for six years without removal. It also afforded the means of a convenient removal of the heating surface, so that in an engine provided

with a duplicate heating surface, the old one could be removed and a new one added, ready for work within three days. It is said that these engines have performed a greater amount of duty than any others extant.

We have now glanced at the various gradations of improvement in the early stages of locomotive building, which it is impossible to contemplate without paying a deserved tribute to the great ability displayed in this branch by Mr. Hackworth, at a time when everything had to be learned —when, indeed, engineers were utterly thrown upon their own resources. No later than 1846, one of the agents of the Stockton and Darlington Company stated, in reference to the last class of the engine we have described, that, "taking them weight for weight, they surpass any engine of the line."

If George Stephenson deserved the title of the "Father of Railways," we think we may at least claim for Timothy Hackworth that of the "Father of Locomotives."

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*American Engineering—Locomotives.**

Continued from page 234.

DISTRIBUNION OF THE WEIGHT UPON THE FRAME.

After the consideration of the framing, and the principles according to which a solid one ought to be constructed, we must next investigate the manner in which the boiler, or body of the engine, should be connected with it, or braced from it.

The usual form of boiler-stay need not be described—it is in principle the same everywhere. In the English engine the fire-box is generally riveted or bolted, at its extremities, to the frame. In American engines, an equalizing beam being used, the centre of which is equidistant from the wheel-centres, in the case of coupled drivers, it is plain, the attachments of the fire-box are best arranged, so that their bearing centres are also equidistant from the centre of the beam. This is attained in the manner shown in figures 1 and 2, page 220, Vol. II.† of this Journal, and in the subjoined view of the "Mohawk." In the manner of carrying the smoke-box or fore-end of the boiler, there is a wide difference between the two systems. In English engines, with a round smoke-box—Stephenson's outside cylinders, the "Jenny Lind" and others—a stay is carried to the frame, the same as for the barrel of the boiler in the engine here shown as No. 1., the wings are carried straight down, and bolted directly to the frame.

In American engines the smoke-box, with its heavy chimney, is a much greater weight, and therefore requires stiffer carriers. Great weight being placed at the top, and acting on the frame with greater leverage, this part must be doubly strengthened. In most inside cylinder engines we find —as in figs. 1 and 2 of the frames—the cylinders to rest on, or sometimes underneath, the broad frame-bar by flanches. The two cylinders are connected together, either directly by flanches cast on, or by a separate casting bolted in between them, and carrying the gudgeon for the centre-

* From the Glasgow Practical Mechanic's Journal, for May, 1850.

† Journ. Frank. Insti., Vol. XIX. pp. 153, 154.

pin. The cylinders, or this intermediate casting, are furnished with top flanches, curved to the radius of the smoke-box, to which the latter is firmly bolted, being thus supported on a broad base. This will be understood by reference to fig. 3, the breadth of base being from 15 to 18 inches.

How many boiler-stays are to be put on the barrel of the boiler?

Some engineers put in as few as possible, only one on the whole length. Some put in more, on the principle of a more equal distribution of the weight along the frame.

Experience has shown that a beam bears one-third more, if loaded along its whole length, than bearing only on the centre. Theory, or science, has proved why it must be so. Inversely, the weight remaining the same, it will be less strained; and therefore, as in the case of a locomotive, a greater proportion of its surplus strength is used to counteract lateral impulses. It may be objectionable to peforate the boiler with more holes than necessary; but it is still more objectionable to produce an unequal straining in the frame, and thus weaken it.

Using only one stay, it is of course placed somewhere near the middle of the barrel. Using more stays, we find them sometimes adjusted near the spring-bolts, as in fig. 2, page 220,* sometimes on either side. The first plan is not a good one; for at the spring-bolt, all the vertical vibration not taken up by the spring is received by the frame, and thence imparted to the boiler. Place the stays between the springs, and the effect imparted to the body of the engine is less than the amount received at the spring-bolt, in the ratio of its distance from it; for the stability is affected only when the wheels on one side do not stand upon one horizontal plane. The frame between two wheel-centres then becomes a lever; at one spring-bolt the force acts, the other is the fulcrum; the effect received by the stay is in the proportion of the two lever lengths.

In many English inside-cylinder engines, as those by Messrs. Sharp Brothers & Co., the transverse plate supporting the guide bars is at the same time a carrier to the boiler. There cannot be a better way of bracing at the same time both the frame-plates and the boiler from them. However the braces or stays are placed, the principle laid down in page 101, Vol. II., should never be lost sight of—that is, so to arrange the fastenings as to admit of the expansion of the boiler, without producing a straining on the frame and working parts. I know that many practical men laugh at this idea as a mere "theory;" but where such very great accuracy and delicacy of adjustment and workmanship is required as in a locomotive, to make it durable, every cause of straining, be it great or small, should be avoided; and in this case it is easy to do so. Granted that the expansion upon a length of 12 feet is scarcely perceptible, it acts injuriously by constant unvaried repetition. Does not every engineer know, that however delicately and firmly he adjusts his slide in a cold state, as soon as it becomes hot its position is slightly altered; and in setting it he makes an allowance?

The boiler stays have another duty to perform. They are not carriers only. By their means the engineer distributes his weight on the wheels in the necessary proportions. The points of support for the engine are those where the frame is suspended from the springs. The longer the spring, therefore, the greater is the base of support; this is the theory, and

* Journ. Frank. Insti., Vol. XIX, p. 154.

practice proves a long spring to be more effectual in steadying the engine than a short one. Taking the "Pyracmon" as shown in Tredgold, we find the length of the spring on the fore wheel to be 39 inches; the distance from the spring-bolt to the centre of cylinder, 5¾ inches; this gives the proportion of overhanging weight. It is still less, considering that the heaviest end of the cylinder is the back end, which throws the centre of gravity somewhat farther back than the centre of length. The greater size of driving-wheel in the "Iron Duke" allows the leading wheel to be brought further forward; and the centre of gravity of the cylinder lies behind the point of support, that is, within the base. In the engine shown in No. 1—the tank engine—the length from the spring-bolt to the centre of cylinder is about 23 inches; that gives its ratio of overhanging weight. In the "Caledonian" outside-cylinder engine, also shown in Tredgold, the length is about 13 inches; in a sketch I made of Stephenson's outside-cylinder engine, 1845, I find it to be 20 inches; and allowing for the difference of the length of stroke—20 and 22 inches—it might, with the same arrangement and a 20-inch stroke, be reduced to 18 inches: all so much in favor of these engines over No. 1.

On referring again to the excellent engravings in Tredgold, we find altogether a better distribution of framing at the front of the "Caledonian" engine than in the tank engiue. As explained, the proportion of overhanging weight in the two, is as 13 to 24. Moreover, the centre of the axle, where the lateral impulse is imparted to the buffer plank, where, on the cylinder side, it is resisted, is in the "Caledonian" engine, 4 feet 2¾ inches. Above all, the centre of the boiler of the first, with 6-foot drivers, is 3½ inches lower in the tank engine than in the second, with 5½ feet, and 5 feet 1 inch drivers, while the boilers are the same size. Both engines running on the same line, under similar circumstances, the first is better adapted to resist oscillation. Moreover, the cylinder is carried by a double frame, 13 feet apart, and its centre line falls within this base; in the tank engine, at a great distance from the centre, it is bolted by one narrow flanch to the frame. At the centre of the cylinder the straining takes place.

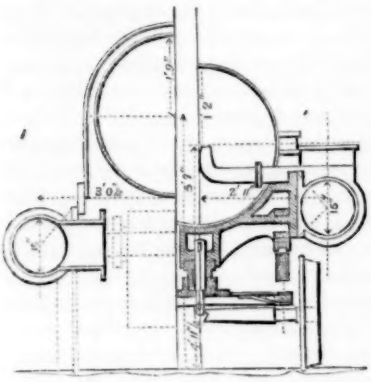

Fig. 3.—¼ inch = 1 foot.

The "Caledonian" certainly has the disadvantage of a high cylinder, lying at considerable inclination; but it is so much better supported and steadied, that this disadvantage is in effect much reduced. Were the length of flues in both the same, then its driving axle might be placed farther back, the length of connecting rod increased, and thus the angle of the stroke diminished, which would still more reduce the effect of the disadvantage.

Before leaving this subject, I refer to fig. 4. It shows part of an engine built here lately, on Crampton's plan, and, with the exception of truck

and equalizing beam, is almost an exact copy. The driving-wheels are 7 feet diameter; the carriers 4 feet; the springs of both are connected by an equalizing beam, the centre of which can be shifted. Placed equidistant from the wheel centres, each wheel bears an equal weight; shifting the centre to one side, any amount of weight can be thrown on the drivers.

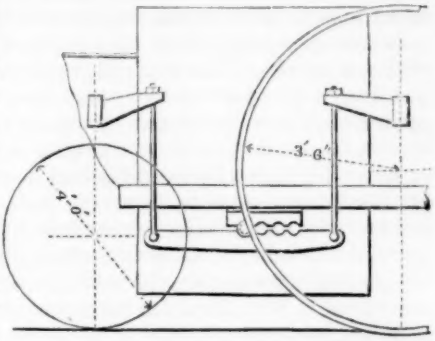

Fig. 4.—$\frac{1}{4}$ inch = 1 foot.

We may now return to the comparison of No. 1 and No. 2. The first is a sketch of an English outside-cylinder engine, the second a corresponding one of an American engine. Their dimensions have been stated at page 219, Vol. II*. Fig. 3 gives half-cross sections of each at the centre of the cylinders, showing the attachments at this part. It may seem bold to place an engine by one of the most renowned firms in England, having at its command the greatest talent and experience, in juxtaposition with one only rebuilt, too, at a railroad workshop, in a town the name of which is scarcely known to the majority of the people of England. But a glance at the cross sections will convince the most sceptical how the one must be unsteady, containing within its construction the very causes of oscillation—high boiler, insufficient fastening of cylinder, and a great overhanging weight—whilst the other will move along the road as steady and smooth as possible.

I am favorable to outside connexions, and in many circumstances prefer them—a predilection which many years' connexion with railroads has not diminished. I think them both safe and economical—(see page 100, Vol. II.)—but they must be judiciously constructed. An engine like No. 1, when she has run a length of time, will be worn out much sooner than one with inside connexions. This will be no proof that outside cylinders are to be deprecated. The fault lies in the builder, not in the system.

In fig. 3, the position of the driving axle is shown by dotted lines. This will show how the position of boiler No. 2 is high enough for a 5½ feet wheel. We must not imagine, therefore, that the boiler is too high for a 5 feet wheel. Engines using wood as fuel require a greater depth of furnace below the barrel of the boiler, *i. e.* below the flues, than coke engines. The boiler in No. 1 is placed 7½ inches higher than need be. Why this inordinate height? It is not alone due to the tank. Even leaving the tank as it now stands, the boiler might have been lowered. But the same cubical content of the tank might have been preserved, had the boiler been lowered these 7 inches, and the top of the tank been curved to the shape of the boiler—thus gaining at the sides what was lost at the centre; or, there is room enough to admit of the eccentrics being shifted 1 or 1½ inches closer to the frame, and then widening the tank. In the distance of the centres of cylinders, an alteration might have been intro-

* Journ. Frank. Insti., Vol. XIX. p. 151.

duced. They are, in No. 1, 6 feet ½ inch apart; No. 2 shows them only 5 feet 10 inches apart, which still leaves ample clearance between the rod and the wheel. Thus, from 2½ to 2⅞ inches might have been gained on the great length of the steam-channels, which would materially have increased the firmness of the attachment of the cylinders.

I show dotted lines from the centres of both cylinders to the centres of the bolts by which they are held to the frame. No. 1 is held by one row; No. 2 by two rows, one above and one below the centre. No. 1 rests against the frame by a flanch just broad enough to admit of the bolt and its nut, for which three inches bearing surface is sufficient. No. 2 has a large bearing base of some 18 inches depth. The flanch in No. 1 might have been increased to reach near the top of the frame, the leg of the smoke box brought a few inches lower down, and then a double row of bolts, one of 5, the other of 4—a total number of about half those now used for this double purpose—would have produced a far firmer and more solid attachment. We must seek for a very firm support to the cylinder, for there is a great strain acting at its centre.

Cæteris Paribus,—the horizontal position of the cylinders in No. 1 is preferable to the inclined position in No. 2. American engineers know this, and admit it. But at what a sacrifice is this advantage gained? For the answer, I refer to the side elevations of the machines. No overhanging weight, the engine stands firm as a rock; with the use of the truck, all straining in curves is avoided. The truck does not admit of large leading wheels. Such small wheels in the English engine, with only one leading axle, would, at great speeds, be unsafe. But while in the American engine the velocity of the axle is increased, only one-half the weight is placed upon it, so that the straining is still even less.

As to the performance of the two engines, I am unable to institute a comparison. They are built for different purposes: No. 1 for speed, No. 2 for power. They are about the same weight: No. 1 is stated to weigh 21 tons; No. 2 weighs about 22 tons. The accounts of performance of the tank engine are too vague to found any comparison upon them.

The truck I have shown under No. 2 is not the one placed under her. It is one lately designed by the same engineer, and already placed under various engines. It is made of wrought iron and boiler plate, with cast iron gudgeons for the centre pin, and its construction will be readily understood from the drawing.

The iron framing in front of the engine is necessary on American lines; they being nowhere fenced in, and cattle frequently abounding in the adjoining fields. They are even called cattle-fenders or cow-catchers. They are the more necessary, as the fire-box, with its ash-pan, reaches so much lower down than in coke engines. Stretching across the whole breadth of track, they clear it most effectually; far more so than the life-guards used in Europe. Certain it is, that on this cattle fender coming in contact with a car, the demolition is more complete; but we must weigh the disadvantage in this case, which can only arise from negligence and the want of proper signals, with the advantages in cases over which there is no control; which, from the want of fences, and the sharpness of curves, may in America be more frequent.

There is one feature in American locomotives which must be deprecated,

and wherein the English engine has the advantage; that is, the too frequent use of cast iron. In many cases, but chiefly where its power to resist compression comes into action, cast iron is greater value than wrought; but wherever it is subject to lateral strains or to torsion, it ought not to be used. I have seen what to English engineers will seem scarcely credible, even rocking-shafts with the levers cast on,—pieces of cast iron of great size and weight, to resist the strains. The high price of the material, and the excessive wages, have led to a more frequent adoption of this brittle material than otherwise would probably have been the case. While the general rate of traveling was slower than in England the evil was not so great. But now, when the speed of from 40 to 60 miles an hour is being introduced, we shall gradually see cast iron less used. Nearly all engines have cast iron jaws for the axle-boxes. The engine No. 2 shows them. To avoid these, the builder designed that admirable wrought iron one, shown in fig. 1, p. 220,* which has since been placed on an engine of the same class on the same road.

These various sketches of frames will show the almost universal use of adjusting keys or wedges for the axle-boxes. I not only think that this plan is better than trusting entirely to accuracy of workmanship, (it may scarcely occur once in fifty cases, still I have known an engine out of a renowned workshop in which the driving-axle was not square with the frame, and the extreme thinness of the box, only $\frac{2}{16}$ths of an inch, rendered planing off and packing impossible, thus causing great expense for the alteration,) but it provides the means for taking up any play which in time may take place from wear.

Cast iron wheels, even 6-foot drivers, are admirably made here. The details of proportions I shall give at a future time, when I propose to give an investigation into the relative merits of the "link" and American expansive motion, for which a series of experiments are now making; also details of construction of various parts, with illustrative drawings.

New York, March, 1850.

AMERICAN PATENTS.

List of American Patents which issued from September 17, to October 8, (inclusive,) 1850, with Exemplications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

SEPTEMBER.

35. For an *Improvement in the Process of Working Gutta Percha;* Samuel T. Armstrong and Charles J. Gilbert, City of New York, September 17.

"The nature of our invention consists in the use of lime or other alkali with heat, to neutralize the acids contained in native or crude gutta percha, and thus preserve and render more permanent its useful properties.

"Our invention also consists in compounding lime with gutta percha, for the purpose of improving its qualities and preserving it wholly or partly from deterioration, and protecting it against the action of heat and the atmosphere."

Claim.—"What we claim as our invention, under the first part of our invention, consists in the use of lime or other alkaline substance with heat, in the manner substantially as herein described, in the cleansing of gutta percha, to neutralize the acid or acids con-

* Journ. Frank. Insti., Vol. xix. p. 151.

tained in that substance in its crude or native state, and thus preserve and render more permanent its useful properties, as specified.

"And in the second part of our invention, we claim compounding lime with gutta percha, substantially as herein described, for the purpose of improving its qualities, preserving it wholly from deterioration, and protecting it against the injurious effects of the atmosphere and heat, substantially as described."

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36. For an *Improvement in the Process of Preparing Cream;* Charles Denison Birdseye, City of New York, September 17.

"The nature of my invention consists in placing a quantity of pure milk in a vessel which is placed in a vapor bath, said vessel having a close cover with a pipe attached, which shall convey the steam and flavor arising from the evaporation of the milk through another vessel containing sugar, thereby preserving the pure flavor of the milk; the evaporation to be continued until the quantity is reduced about one-half, when the sugar is to be mixed in the milk, and the evaporation continued in an open vessel, (the same being constantly stirred,) until the whole becomes granulated, when it is dried sufficient to be reduced to a powder. The quantity of the sugar may be varied as desired."

Claim.—"What I claim as my invention is the process described herein, of distilling milk, and condensing the same in sugar, for the purpose of preserving the flavor, as set forth."

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37. For *Improvements in Spike Machines;* William Blake, Boston, Massachusetts, September 17.

Claim.—"I claim the heading and carrying nippers, in combination with the shears, the header, and the griping mechanism; the same being made to operate in connexion therewith, substantially as specified.

"And in combination with the lower nipper, I claim the spring catches, latching and unlatching apparatus applied to it, for the purpose specified."

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38. For an *Improvement in Machinery for Ginning or Picking Cotton;* Francis Alton Calvert, Lowell, Massachusetts, September 17.

"The nature of my invention consists in an improved machine for picking cotton: that is, in a machine by which the fibres of cotton are torn from the seeds, and from any other extraneous matter which may be mixed with them, whereby the separated fibres are less broken after the operation of such picking than is the case with machines which have heretofore been used for the same purpose."

Claim.—"What I claim is the combination of such parts as I have shown, forming a picking machine, and their mode of action, as hereinbefore described."

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39. For an *Improvement in Processes for Preparing Wheat for Grinding;* Joseph W. Carpenter, Pontiac, Oakland county, Michigan, September 17.

"The nature of my invention or discovery relates to treating of wheat and other grains with an acid or a mixture of acids, to remove humidity from the grain, and make the skin or hull more easy of separation from the flour or starchy part of the grain with a less pressure of the mill stones in reducing the grain to flour or meal; thereby producing a greater amount of fine meal or flour from a given quantity of grain, (about seven per cent.,) also giving to the grain, for storage or carriage in vessels, greater preservative qualities."

Claim.—"I claim the application of an acidulous composition to wheat or other grain, the said composition being principally vinegar; but I do not limit my claim to the exact composition of acids as herein described while the same effects can be produced by the vinegar alone, or when combined with one or more of the other acids, especially with the sulphuric acid, for the purposes set forth."

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40. For an *Improvement in Paper Filers;* William A. Collord, Cincinnati, Ohio, September 17.

Claim.—"What I claim as new, are, 1st, the arrangement and construction after the manner substantially as described, of a box or receptacle for documents or papers, having

a lid fitting loosely within it, which is made to press down upon the papers by a spiral or other suitable spring.

"2d, The rod or its equivalent attached to the lid, and moving in the guide slits or apertures in the sides of the box, the said slits terminating in a notch or shoulder at their upper extremities, for the reception and retention of the rod during the manipulation and examination of the file."

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41. For an *Improvement in Grain Harvesters;* Ebenezer Danford, Jr., Geneva, Kane county, Illinois, September 17.

"The nature of my invention consists in the application of two sickles to a reaping and mowing machine, working together in opposite directions at the same time, so as to throw the weight of the moving parts upon opposite sides of the centre of the crank orbit."

Claim.—"What I claim as my invention, is the application to a reaping and sowing machine of two sickles, working together in opposite directions as set forth, so as to throw the weight of the moving parts upon opposite sides of the centre of the crank orbit, for the purpose set forth."

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42. For an *Improvement in India Rubber Hose;* Horace H. Day, Jersey City, New Jersey, and Richard McMullen, Great Barrington, Berkshire county, Massachusetts, September 17.

"The nature of our invention consists in forming water-tight and durable hose from India rubber and fibrous substance, so arranged as to impart strength, and yet prevent mildew to the fibrous substance, which is the source of decay to other kinds of rubber hose."

Claim.—"What we claim as our invention, is the making of flexible hose or pipe, by combining India rubber leather with a tube of rubber, substantially as herein described, the whole being united, forming one solid tube, making a strong, durable, and flexible hose, adapted as a substitute for leather and other similar pipes for the conveying of fluids."

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43. For an *Improvement in the Plough Clevis;* Gerrett Erskon, Hobart, Delaware county, New York, September 17.

"The purpose of my invention is to guide and direct the movement of plough beams in such manner as to make the depth of the furrow and its breath, conform to the requirements of the land to be tilled."

Claim.—"What I claim as new, is so making a clevis with teeth or prominences and cavities on the front surface of a socket, matching with corresponding depressions or cavities and elevations on the surface of a movable bar, that the bar and socket when set together by a screw, or other equivalent fastening, in the required position, may have numerous bearings, and be wholly prevented from either sliding or revolving in any direction, without breaking the continuity of materials, of which the parts are composed.

"I also claim in combination with a series of radial ridges, or a circle of cavities on the end of a clevis socket fixed at the extremity of the plough beam, a series of teeth or of conical points on a movable clevis-bar, so adjusted to each other, that the guide-hole of the clevis-bar may be held in any required position, and at any necessary distance from the axis of the beam without relying on friction of the surfaces to prevent slipping, in the manner and for the purposes herein set forth.

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44. For an *Improvement in Printing Machines;* John B. Fairbank, Leon, Cattaraugus county, New York, September 17.

"The nature of this invention consists in arranging within a suitable case a series of sets of inclined wires or rods, attached to bent plates at their upper ends, upon which rest keys. The keys, plates, and wires being supported by coiled springs, each set of wires being brought within a small compass at the bottom, and having type upon their lower ends, marked with characters indicating letters, and sounds of letters, and capable of being inked and pressed against a sheet of paper, either singly or in connexion with others—by pressing on said keys. The keys working changes upon the type. I use in our machine forty-eight entire and separate alphabets. Each of which comprises a vowel and a consonant alphabet, separate and distinct from each other. In writing, I use a vowel alphabet

for every vowel character printed in a line upon the paper, and a consonant alphabet for every consonant character in one line. Each vowel alphabet has fifteen keys, and their attachments by which changes are wrought upon five wires, and their attached type, to make either of the fifteen vowel characters. And each consonant alphabet has twenty keys and their attachments—working changes upon six wires or type for making either of the consonant characters used.

"In writing, letters or sounds indicated by characters, are selected from the various alphabets—one letter from each. The characters upon the keys taken, expressing the sounds of the words written, observing to select the alphabets in the order in which the sets of type (the five and six type forming one set) are arranged above the paper (one-eighth inch from it.) At the end of every line written, the ink-roller is forced under the type, and the paper-carriage moved by the foot or hand."

Claim.—"What I claim as my invention, is the mode of representing letters, and the sounds of letters, by means of characters made by changes wrought upon a less number of movable type than the number of letters or sounds of letters represented. The type being made upon, or attached to the bottom of wires or rods which are worked by keys, at or near the top, substantially as herein set forth."

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45. For an *Improvement in Corn Shellers;* Samuel L. Graves, Springfield, Sangamon county, Illinois, September 17.

"My process of stripping the grains of corn from the cob, consists in forcing the ears separately between a set of shelling plates, while, at the same time, they are twisted on their axes."

Claim.—"What I claim as my invention, is the device herein described for twisting and forcing the ears of corn between spring shelling plates, substantially as herein set forth."

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46. For an *Improved Tool for forming Plaster Cornices and Mouldings;* Sylvester Groesbeeck, City of New York, September 17.

"My invention consists in arranging the mould or former in a square frame, at an angle of 45° with the sides of the square, or, in other words, upon the diagonal of the square of the frame containing the mould, by which arrangement, provided the angles of the room upon which the moulding is to be placed are all at right angles or angles of 90°, it is only necessary for the moulder upon reaching the angle, to place the adjacent side of the square upon the walls, and continue as before."

Claim.—"What I claim as my invention, is arranging a former for making mouldings upon the walls and ceilings of a room, upon the diagonal of a square frame, and making an angle of 45° with each side of said square, for the purpose and in the manner described."

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47. For an *Improvement in Daguerreotype Plate Holders;* George Mallory, City of New York, September 17.

"My invention consists of a single block to which the Daguerreotype plate is securely clamped by one or more springs secured to the sides or ends of the block, in such manner that all the operations to which the plate is subjected by the Daguerreotyper, can be effected without removing the plate from the holder, while at the same time the plate is quickly and readily either clamped to, or removed from, the face of the block."

Claim.—"What I claim as my invention, is the Daguerreotype plate-holder, constructed substantially as herein described, of a block with a spring edge, by which the plate is secured to it."

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48. For an *Improvement in Spring Beams to Ploughs;* William Morrison, Carlisle, Cumberland county, Pennsylvania, September 17.

"My plough is of that class known as gang-ploughs, and my invention consists in a spring draft-bar to which the team is hitched, and in the method of attaching the plough-irons to their respective beams."

Claim.—"What I claim as my invention, is, 1st, the adjustable spring-bar interposed between the point of draft and the frame of the plough in the manner, and for the purpose herein set forth."

49. For an *Improved Roadway for Rail-Cars and ordinary Vehicles;* Jordan L. Mott, Mott Haven, Westchester county, New York, September 17.

"The nature of my invention consists in making the rails each with a curved, or trough-like projection outward and downward from the upper and outer edge of the rail, and in combination therewith, to the level of the edge of which projections the road-way is to be paved; the said projections of the rail being a gradual curve or inclined plane from the upper edge of the rail, that the wheels of common carriages may pass over the rail with facility, and when running thereon, may have a tendency, by reason of the inclined or curved face, and the weight of the carriage to descend from the rail; and thus, at the same time, keep the other from the inner edge of the other rail, if the gauge of the carriage be the same, or nearly the same, as that of the rails; and if it be of a wide gauge that the two wheels in running thereon, may straddle the rails, and run on the outside of both.

"My invention also consists in making the inner edge of the rail with an inclined, or trough-like projection, in combination with the above mode of making the projection on the outer edge."

Claim.—"What I claim as my invention, is the method substantially as herein described, of making rails for the roadways of streets, &c., by combining with the rails on which flanched car wheels run, outer faces of sufficient breadth for the wheels of common carriages to run, made curved or inclined from the top of the rail, substantially as described.

"And in combination therewith, I also claim making wide faces on the inside of the rails substantially as described, for the wheels of common carriages to run on, as described."

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50. For an *Improvement in Cast Iron Rail Road Car Wheels;* Benjamin Severson, Schenectady, New York, September 17.

"The nature of my invention consists in having the sides of the hollow part of the wheel symmetrical in form and amount of metal, having an equal amount of surface internally and externally, thus insuring an equal amount of contraction in cooling, having the sides united in one thickness of plates at points nearly equidistant from hub and tread. And the parts adjacent to these plates united to them in the form of pointed arches, the parts between these plates raised so as to give the wheel sufficient lateral strength; and these raised parts will take nearly the form of hollow arms, having their radial sides curved inward or toward each other, and not have any portion of them bulged or curved outward, thus having all parts well bound together, giving the whole a great amount of lateral strength, to resist wrenching, and yet all parts of the metal nearly in the direction of the stress or force acting upon them."

Claim.—"What I claim as my invention, is a cast iron wheel in one piece, having the rim connected to the hub by two plates joined together at intervals, at points as small as may be, and nearly equidistant from the rim and hub—said plates being of such form, that each section by the plane of the axes, passing through the points of union, shall present two pointed arches, uniting at the apex, the one springing from the ends of the solid hub, and the other from the edges of the rim; and a similar section between the points of union, shall bestow flat curved lines bending towards each other, and joining the ends of the solid hub with the edges of the rim; and a circular section passing through the points of union of the two plates, shall produce a double series of flat arches, united to each other at their ends. The whole being constructed substantially in the manner and for the objects set forth."

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51. For an *Improvement in Sewing Machines;* John Bachelder, Boston, Massachusetts, September 24.

Claim.—"What I claim as my invention, is the machinery herein described for making the stitch, viz., the combination of the hook, the plier, and needle, as constructed and made to operate together, substantially as described."

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52. For *Improvements in Looms for Weaving Tapestry and Brussels Carpets;* Erastus B. Bigelow, Clinton, Worcester county, Massachusetts, September 24.

"The nature of my invention, is causing the movable guides and supports—which have a vertical movement—to open and close, so that the wire shall be introduced when they are closed, to insure the introduction of it in a proper position, and when in place, that it may be liberated by the opening of the guides or supports.

"And the second part of my invention consists in the employment of a stop motion to be operated by the wires as they are introduced, so that when the wire fails to be introduced, the loom shall be stopped."

Claim.—"What I claim as my invention, is closing and opening the supports or guides as they are raised and depressed to receive and support or guide the wires, and to liberate them in manner substantially as herein described."

"And I also claim the employment of a stop-motion in looms for weaving looped or piled fabrics, in which the pile is formed on wires for the purpose of stopping the loom whenever a wire fails to be introduced, substantially in the manner described."

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53. For an *Improvement in Processes for Refining Gold;* James C. Booth, Philadelphia, Pennsylvania, September 24.

"The nature of my invention consists in the preparation of a solution of gold, alloyed with silver or other metals, so as to convert them into chlorides; and a precipitation of metallic gold upon the chloride of silver and other insoluble chlorides; and in the subsequent reduction and extraction of the silver or other metals from those insoluble chlorides; or the direct extraction of their chlorides by solution in the manner hereinafter set forth, so as to leave the gold pure."

Claim.—"What I claim as my invention, is, 1st, the process of dissolving alloyed gold for refining it, by developing nitric acid, or both nitric and muriatic acids gradually from their salts, in the manner, and for the purpose set forth in the specification.

"2d, I claim the process of precipitating gold from its solution, and removing therefrom the insoluble chlorides, as set forth.

"3d, I claim the process of refining alloyed gold without the use of silver, so as to form a solution of gold and other metals, and a residue of chloride of silver and of other insoluble chlorides, and then precipitating metallic gold upon those insoluble chlorides in the same vessel without transfer after the solution is effected; and afterwards dissolving out the insoluble chlorides from the gold; or reducing the insoluble chlorides to the metallic state in the wet way, and dissolving out the metals from the gold, all in the manner hereinbefore described.

"4th, I claim the process as described of dissolving alloyed gold in wooden vessels, which may be made of any dimensions, corresponding to the extent of the operation.

"5th, I claim the process as described of dissolving alloyed gold, by blowing steam directly into the solvent liquids, all in the manner as hereinbefore described."

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54. For an *Improvement in Grain Cleaning Machines;* George W. Bowers, Leitersburgh, Washington county, Maryland, September 24.

"My invention is based on the fact that garlic is softer, and can be much more easily compressed than sound wheat with which it is mixed. I therefore present the wheat to be cleaned to the face of a revolving barrel, formed of staves, having flaring slots between them sufficiently large at the outer faces of the staves to receive the grain, but small enough at the inner faces of the staves to prevent its passage between them. The grain in the slots is subjected to the pressure of the teeth of one or more series of wheels, by the action of which the smutty grains are crushed, and the garlic compressed and pushed through the narrow opening of the slots into the hollow centre of the barrel, and discharged through openings in its head, at the side of the machine. By the revolution of the barrel, the good wheat is discharged from the flaring mouths of the slots into a funnel beneath the barrel from which it is delivered in a thin sheet, upon an inclined plane down which it runs to be discharged from the machine; during the delivery of the grain from the funnel, and its passage down the inclined plane, it is subjected to a strong current of air produced by a fan attached to the machine, and all dust and dirt are expelled."

Claim.—"What I claim as my invention, is the combination of the revolving slotted hollow barrel with the toothed wheels, the same being arranged and operated substantially in the manner, and for the purpose herein set forth."

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55. For an *Improvement in Machines for Fumigating Plants;* David Stephens Brown, Old Kent Road, county of Surrey, England, September 24; anté dated September 13, 1849.

Claim.—"I claim the combination in apparatus or instruments for fumigating purposes of a destroying magazine, containing the fumigating or obnoxious substance, with a

cylinder and exhausting fan or wheel, whereby the smoke is drawn in at one part of the cylinder, and driven out at another; and whereby also the atmospheric air necessary for the combustion of the substance is drawn into it by the said fan or wheel, both as before described."

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56. For an *Improvement in Machines for Making Ropes;* Henry Evans, New Bedford, Massachusetts, September 24.

"My invention consists in supporting the frame of the gears and strand spindles on the main laying shaft alone, and combining with the said frame and the main frame of the machine suitable machinery, whereby the said frame of the gears and strand spindles may be either clamped to the main frame, or so fastened as to be prevented from revolving, while the main laying shaft and strand spindles are in revolution on their respective axes, or be unclamped, or unfastened, as occasion may require, and for the purpose of enabling the strand to be laid or twisted together, without previous removal from their spindles, as will be hereinafter more particularly explained."

Claim.—"What I claim as my improvement, is to support the frame of the gears and strand spindles on the main laying shaft alone, and combining with the said frame and the main frame of the machine the lever or suitable machinery whereby the said frame of the gears and strand spindles may be either clamped to the main frame, or so fastened as to be prevented from revolving, while the main laying shaft and strand spindles are in revolution on their respective axes, or be unclamped or unfastened therefrom as occasion may require, and for the purpose of enabling the strands to be laid or twisted together without previous removal from their spindles, as heretofore practised and above described."

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57. For an *Improvement in Stop-motion of Looms;* Elijah Hall, Cabotville, Hampden county, Massachusetts, September 24.

"The nature of my invention consists in allowing the lower end of the reed to hang free until the lathe arrives within a short distance of putting in the filling, when it is securely held in a position for filling by means of a movable bar passing across the back of it, and attached by arms or brackets to a shaft working in bearings attached to the under side of the lathe; the said movable bar being fixed by two snecks on the ends of two arms of levers passing through the lathe, and working on centres attached to the front of the lathe, being operated by coming in contact with a spring attached to the breast beam of the loom. The reed is so hung, that in consequence of any obstruction in throwing the shuttle it will be freed entirely from the movable bar as the lathe moves forward."

Claim.—"What I claim as new, is the manner herein described, of securing the movable reed-bar and reed while the filling is being put in, and releasing them after the filling is completed, by the combination of the levers having arms and snecks, and the springs; the whole being arranged and operated in the manner, substantially as herein set forth."

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58. For an *Improvement in the Construction of Threshing Machines;* Darius W. Harris, Yorkshire, Cattaraugus county, New York, September 24.

"My invention consists, 1st, in dispensing with what is usually termed the concave, and in substituting a toothed cylinder in its place; 2d, in constructing the toothed cylinders of annular sections, which are arranged upon shafts in such manner, that when the teeth of any one section meet with any obstruction which they cannot break, that section ceases to revolve while the others continue to act."

Claim.—"What I claim as my invention, is the threshing cylinders, constructed of fast and loose sections; the fast sections of one cylinder being opposite the loose sections of another, substantially as herein set forth."

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59. For an *Improvement in Burning Fluids;* Ephraim Howe, Brooklyn, New York, September 24.

"The nature of my invention or discovery consists in compounding the flour of rosin, and the essential oils obtained by distilling whiskey or other liquors from grain or other vegetables; such essential oils being the residuum of whiskey or other liquors, after the same is distilled or rectified."

Claim.—"What I claim as my invention, is the compounding rosin and the essential oil of vegetables or grain, (when the same is produced by distillation of whiskey or alco-

holic liquors, and thereby become a refuse article,) for the purpose of making a material from which to make gas. Also for a burning fluid as set forth herein, whether compounded in the precise proportionate quantities set forth, or other quantities which will produce substantially the same result, all of which is fully set forth herein."

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60. For an *Improvement in Machinery for Drawing Hemp and Parting its Fibres;* O. S. Leavitt, Maysville, Kentucky, September 24.

"The object of my invention is to reduce the fibres of slivers of flax or hemp to a nearly uniform length, by breaking the long fibres contained in such slivers, and to this end, the principle or character of my invention, which distinguishes it from all other things before known, consists in combining a rotating cam or cams with two sets of holding fluted rollers, between which the sliver or slivers pass, and by which it or they are held; the second set of fluted rollers, which deliver the said sliver or slivers, being geared to rotate with greater velocity than the first set."

Claim.—"What I claim as my invention, is the employment of two sets of holding and drawing rollers, substantially as herein specified, in combination with a rotating cam or cams, or the equivalent thereof, for each sliver, in the manner and for the purpose substantially as described."

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61. For an *Improvement in Casting Stereotype Plates;* Jason M. Mahan, Philadelphia, Pennsylvania, September 24.

"The nature of my invention consists in providing a dipper composed of iron, brass, or other material, to be used instead of the common dipping pan. This dipping pan is composed of several parts, and so constructed as to receive the moulds in a vertical position, or nearly so, with the face of one mould towards the back of another, by which mode any desired number of plates may be cast at the same operation, or at any one operation, being limited only by the number of moulds, the quantity of metal employed, the capacity of the melting pan, and the size and capacity of the dipper."

Claim.—"What I claim as my invention, is the employment of the dipper, constructed substantially as described, in the vertical casting of stereotype plates, in the manner herein set forth."

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62. For a *Process of Reducing Gold Bullion;* Richard S. M'Culloh, Princeton, New Jersey, September 24.

"The nature of my invention and discovery consists in bringing gold bullion, containing silver or other impurities, into a loose, divided, pulverulent, or spongy state, texture, or disintegrated molecular condition, so that all impurities it may contain can readily be removed by acids."

Claim.—"What I claim as my invention and discovery, is, 1st, the reduction of argentiferous and other gold bullion, as a preparatory process in the art of refining thereof, into a pulverulent or spongy state, or a disintegrated molecular condition, by the means, particularly of fusion therewith, and the subsequent removal by acids therefrom, of zinc or other metal baser than silver, which will produce the desired effect, for the purpose of then separating by acids, from such gold bullion, the silver and other impurities which it may contain, without quartation with silver or any intermediate process, in order to fit the gold for coining and other uses.

2d, I also claim, in addition to the above processes, the pulverising by grinding, crushing, or percussion, of gold bullion rendered brittle by union with lead, solder, or other like base metal, for the purpose set forth.

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63. For *Improvements in Removing Electricity from Wool in the Process of Manufacture;* Joseph Metcalf, Worcester, Massachusetts, September 24.

"My improvement in the woolen manufacture consists in the discovery of a method of preventing the divergence of the fibres of the wool by electricity, without the employment of oil for that purpose; this method consists in the removal of the electricity from the wool by suitable conductors which may be formed and arranged in various ways to suit different circumstances."

Claim.—"I claim as my improvement in the manufacture of wool, the removal of electricity from its fibres, substantially in the manner and for the purpose herein set forth, but

irrespective of the form, arrangement, or construction of the apparatus by which such removal of electricity is effected."

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64. For an *Improvement in Heating Elevated Ovens;* P. A. Palmer, Le Roy, Genesee county, New York, September 24.

"The nature of my invention consists in the arrangement of revertible flues in elevated ovens; secondly in the arrangement of a grate in the four-boiler-hole elevated oven stove, so as to build the fire under the back boilers and nearer the oven for summer use, requiring less fire to heat the oven and two boilers than when the fire is made in the front part; and lastly, in the manner of making oven grates, so that they may be drawn nearly out of the oven, and support themselves with the weight of articles that may be placed upon them for baking."

Claim.—"What I claim as new, is the arrangement and combination of revertible flues in elevated ovens of cook stoves, in the manner and for the purpose described."

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65. For *Improvements in Machinery for Fulling Cloth;* Charles A. Read, joint inventor with, and assignee of, Thomas Cotter, New Hartford, Oneida county, New York, September 24.

"The nature of our invention consists in fulling fabrics by means of toothed cylinders operated by power machinery."

Claim.—"What we claim as our invention, is the above described mode of fulling fabrics by means of toothed cylinders by power machinery, the fabric being fed between the fulling toothed cylinders by means of feeding rollers, through guides, with sufficient rapidity to prevent all strain upon the fabric, and at the same time to supply the fulling cylinders which receive the fabric, full it, and then pass it out between two cleaning rollers, which receive it from the fulling cylinders prepared for other processes. The movements of the several parts of the machine being produced by a combination and adjustment of mechanism similar to that herein described, or any other which may be substantially the same, and by which analogous results may be produced."

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66. For an *Improvement in Water Wheels;* Timothy Rose, Cortlandtville, Cortlandt county, New York, September 24.

Claim.—"What I claim as my invention, is making the discharge aperture of the shutes movable relatively to the axis of the wheel, or the axis of the wheel movable relatively to the aperture of the shute, substantially as described, for the purpose of varying the effective diameter of the wheel, and thereby increasing or decreasing the velocity thereof, substantially as described."

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67. For an *Improved Machine for Forming and Charging Percussion Caps;* George Wright, Washington City, D. C., September 24.

Claim.—"What I claim as new, is, 1st, the combination of the several motions given to the sheet of metal, by which it is presented to the cutting punch by an intermittent motion from right to left, and *vice versa;* and when the edges are reached reversing the direction, and at the same time advancing the sheet, so that the blanks are punched in successive rows across the sheet, substantially as set forth.

"2d, I claim the chisel moving with the punch stock, by which the perforated sheet is cut into strips for removing it piecemeal from the machine, substantially as described.

"3d, I claim giving such a form to the slots of the carrying plate that the caps, when lifted from the shaping die, are caught by them and taken on, substantially as described.

"4th, I claim, in combination with the slots of the carrying plate, the conducting groove, by which the caps are guided transversely in the slots, and made to present themselves accurately under the charger and polisher, and to drop out when completed, through holes at the end of the slots, substantially as described.

"5th, I claim operating the cap-holder and the revolving polisher or pressing punch by a single cam, in connexion with the strong and weak spring, substantially in the manner and for the purposes set forth.

Lastly, I claim the combination in one automatic machine of the several processes, by which the percussion caps are cut out of a sheet, shaped, charged, and the charge polished down, substantially in the manner described."

Re-Issues.

1. For an *Improvement in the Manner of Constructing the Truss Frames of Bridges and other structures;* William Howe, Springfield, Massachusetts; patented August 3, 1840, re-issued September 3, 1850.

Claim.—"What I claim as my invention in the construction of truss frames, is the method of uniting the upper and lower stringers without attaching them to the interposed timbers, by the combination of the straining blocks, with the timbers interposed for keeping the stringers apart, and the tension rods for drawing them together, substantially as described, whereby the camber can be regulated with facility along the whole or any portion of truss, as described."

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2. For an *Improvement in Stoves;* Anson Atwood, Troy, New York; patented May 14, 1850, re-issued September 17, 1850.

Claim.—"What I claim as new, is the air chamber in which the air is heated previously to its admission to the fuel, in combination with the aperture by which the heated air is caused to impinge on the upper surface of the fuel, substantially in the manner and for the purposes as described."

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3. For an *Improvement in Brick Presses;* Isaac Gregg, Philadelphia, Pennsylvania; patented June 6, 1848, re-issued September 17, 1850.

Claim.—"What I claim as my invention, is the making of the moulds of extra depth, in combination with the elevation of the bricks in the moulds, after they have been pressed a distance equal to the extra depth given to the same, and the removal of the surplus thickness of the bricks, (raised above the tops of the moulds,) by a knife or its equivalent, for the purpose of giving uniform solidity and perfection of form to the bricks prior to their final removal from the moulds, substantially as set forth."

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4. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts; patented November 10, 1840, re-issued September 17, 1850.

Claim.—"I claim a platen raised and lowered by machinery, substantially as described, in combination with the movable tympan plate on which the sheet of paper is placed, and the bed supporting the type with their faces downwards; the whole being arranged and operating together substantially in the manner and for the purpose set forth.

"I claim supplying the press with paper, and removing the same after it is printed, into a box attached to the tympan carriage, by means of a vibrating table, operated by a cam a' on the shaft I, in combination with a frisket constructed as described, connected to the frame of the tympan plate, and pressed down upon said plate by a spring, and raised when the tympan carriage recedes with the printed sheet, by means of a cam o' on the shaft I, through the intervention of a bar with a roller, shaft y', and angular piece of metal; the whole being arranged and operating together substantially as set forth.

"I claim grooving or channelling the fountain roller, or plate under the same, in the manner and for the purpose mentioned.

"I claim the peculiar combination of machinery for the lateral vibration of the distributing roller, said combination consisting of the pulleys v^2 on the shaft B, band, pulleys x^2, rod y^2 z^2, lever, rod e^3 f^3, shaft g^3, and distributing roller frame; the whole being arranged and operating together substantially in the manner and for the purpose mentioned.

"I claim the use of the side strips and cross strips, or either of them, in combination with a tympan supported by the platen plate, the said combination forming a pair of nippers, as it were, for rigidly holding the sheet, however small the margin may be, until it is effectually free or disengaged from the form after an impression is produced."

Additional Improvements.

1. For an *Improvement in Tailors' Measures;* Amos Stocker, Ogdensburgh, St. Lawrence county, New York; patented May 28, 1850, additional improvement annexed September 3, 1850.

Claim.—"What I claim in these letters patent additional, in the combination of the

socket and rule, fig. 6, 7, with the instrument represented at fig. 2; also the socket in the arms 6 7 as represented; also the manner of connecting the two instruments together by bar P P, for the purpose of ascertaining the slope of both shoulders at one operation; also the additional width of the lower arm, and the combination of the groove and slide R S, and rule X, with the lower arm, as represented at O 8, as set forth."

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2. For an *Improvement in Apparatus for Splitting and Stretching Leather;* Bradford Rowe, Albany, New York; patented April 30, 1850, additional improvement annexed September 10, 1850.

Claim.—"I claim the improvement of the apparatus for splitting and stretching leather, secured to me by letters patent in April, 1850, by adding thereto an additional apparatus for stretching leather, especially belting; said apparatus consisting of the combination of two rods placed one above the other in juxtaposition, the upper rod maintaining two clamps to hold the leather to be operated on, the one clamp fixed to one end of the rod, the other clamp movable along the rod; the said rod being separable from the machine with the leather, after the same has been stretched, for the purpose of allowing the repetition of the stretching operations with another similar rod and another piece of leather; the under rod to be a permanent attachment to the machine, but movable along its own length, by the wheel-work of the machine or otherwise, so that when the upper rod is temporarily secured to it by one end near the fixed clamp, and the other clamp is held in its position, the two clamps may be gradually separated, stretching the leather lying between them, substantially as set forth."

Designs.

1. For a *Design for Bust of Daniel Webster;* John C. King, Boston, Massachusetts, September 17.

Claim.—"What I claim is the design of a bust of Daniel Webster, as represented."

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2. For a *Design for a Blower Stand;* Walter Bryent, Boston, Massachusetts, September 24.

Claim.—"What I claim is the new design described for a blower stand, consisting in forming the two halves of said stand in the form of an ancient lyre frame, ornamented with volute scrolls, as set forth."

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3. For a *Design for Plates for Registers, Ventilators, &c.;* Charles F. Tuttle and James S. Bailey, Williamsburgh, Kings county, New York, September 24.

Claim.—"What we claim is the particular configuration or design of open scroll or fret work, substantially as described."

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4. No. 2.—Title and claim same as the above.
5. No. 3. " " "
6. No. 4. " " "
7. No. 5. " " "
8. No. 6. " " "

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9. For a *Design for Stoves;* Learned & Thatcher, assignees of Reuben J. Blanchard, Albany, New York, September 24.

Claim.—"What I claim is the designs and ornaments, consisting of cornucopias and fruits issuing from them, and of vines and leaves issuing from scrolls, as described."

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10. For a *Design for Stoves;* Joseph G. Lamb, Cincinnati, Ohio, September 24.

Claim.—"What I claim is the combination and arrangement of the shapes, figures, ornaments, flutes, and mouldings, into the above represented style and design for coal heating stoves, substantially as shown."

11. For a *Design for Stoves;* Joseph G. Lamb, Cincinnati, Ohio, September 24.

Claim.—"What I claim is the combination and arrangement of the mouldings, shapes, figures, and ornaments, into the design for cooking stoves, substantially as shown."

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12. For a *Design for Stoves;* William Savery, New York, September 24.

Claim.—"What I claim is the peculiar combination and arrangement of the several ornamental figures and mouldings forming the original design of this stove, as described."

OCTOBER.

1. For an *Improvement in Wrought Iron Car Wheels;* Herrick Aiken, Franklin, Merrimac county, New Hampshire, October 1.

Claim.—"What I claim, is the combination of the rim with the arms at the ends of the spokes, by means of the inner flanch, and bevel between the flanch and opposite side of the rim."

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2. For an *Improvement in Cotton-stalk Harvesters;* Stephen Bowerman, Detroit, Michigan, October 1.

"The nature of my machine consists in the construction of a frame of suitable width to pass between the rows or drills, and mounted on wheels for the purpose of being propelled by any power applied to it, which frame is also provided with two wheels, and attached to said frame by means of upright shafts, in such a manner as will allow them to revolve at ease—said wheels are provided with teeth attached to their rims, (not unlike large saw teeth,) these wheels are made of a sufficient diameter to project far enough from the sides of the frame to allow the teeth to come in contact with the stalks, which are extracted by the operation of drawing the machine between the rows or drills."

Claim.—"What I claim as my invention, is the combination of two saw teeth wheels with the frame, and supported thereby, and the triangular pieces of iron for disengaging the stalks, in the manner and for the purposes set forth."

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3. For an *Improved Double Acting Rocker for Washing Gold;* Arnold Buffum and Philip Thorp, City of New York, October 1.

Claim.—"What we claim as our invention, is the combination of the movable pan with the gold washing rocker, so arranged and operated as to give to the pan inside of the rocker, a double rocking or vibrating motion, sidewise and endwise, substantially as described."

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4. For an *Improvement in Mills for Grinding;* W. P. Coleman, New Orleans, Louisiana, October 1.

Claim.—"What I claim as my invention, is the elastic cushion inserted in the bottom of the socket of the cock-head, substantially in the manner and for the purpose set forth."

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5. For an *Improvement in Slides of Seed Planters;* Robert J. Colvin, Lancaster, Pennsylvania, October 1.

Claim.—"What I claim as new, is the combination of the reversing slides with each other and the hopper, by which the machine can be readily adapted to different varieties of planting, in the manner and for the purposes set forth."

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6. For an *Improvement in Vegetable Cutters;* Reuben Daniels, Woodstock, Windsor county, Vermont, October 1.

"My vegetable cutter is composed mainly of a hopper in which the vegetables are introduced, and of a curved reciprocating hopper bottom, which is furnished with a double edge knife, and is caused to move to and fro beneath the hopper, by means of suitable mechanical devices, in such manner that the substances introduced within the hopper are alternately acted upon by the opposite edge of the knife; the hopper is also fitted with removable cutter bars which support the articles introduced within it against the action of

the knives, and which can be removed whenever the articles are of such size that they would be prevented by the bars from coming in contact with the moving bottom."

Claim.—"What I claim as my invention, is the combination of the double-edged reciprocating blade with the hopper and removable bars, for slicing vegetables, substantially as set forth."

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7. For an *Improvement in Looms;* William M. Chace, Boston, Massachusetts; assignee of Halvor Halvorson, Northampton, Massachusetts, October 1.

Claim.—"I claim the combination of the stationary circular plate, the gears, the circular box, with the tubular shaft, and the main shaft; the same being for the purpose of effecting the rotations of the cam shaft, without any such exposure of gears as is customary in most other looms, and which are not only often productive of accidents to attendants or workmen, but often destroy or injure the shuttles when thrown out of the lay by the action of the pickers.

"I also claim the combination of mechanism for operating the harnesses, when they are constructed substantially as specified, the said combination consisting of the supporting or radial bars of the harness frames, the rocker shaft and tubular shaft, the arm, and its pin or stud which enters the groove of the cam, and the endless chain and fixed pulleys; the whole being applied together, and made to operate essentially as described.

"I also claim the mode of constructing each of the harness frames, viz., of a combination of a bar, and thread carriers, as applied together, and made to operate as described.

"I also claim the combination of an endless belt, and its projection or picker with each shuttle box and its picker staff, so as to constitute the floor or bottom of the shuttle box, and operate and be operated in manner as described.

"I also claim the combination of mechanism for operating each picker staff, the same consisting of the cord and pulley attached to it and the main frame, the spring of the foot of the picker staff, the spring latch on the lay, and the discharging cam or plane, affixed to one of the harness frames, the whole being as above described.

"I also claim the mode described of making the race beam, viz., with elevations or plates to extend above it, and between and above the lower warp threads, and so as to constitute a support for the shuttle in its passage over the race beam; the same enabling me to protect the yarns from injury from the shuttle, and to run the loom at a greater velocity than it would be safe to operate it with a race beam constructed in the ordinary manner."

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8. For an *Improvement in Rice Harvesters;* J. J. Herndon, Marlborough District, South Carolina, October 1.

Claim.—"What I claim as my invention, is the application of the vertical blade and wing attached to either or both sides of a beam, and their combination with each other, and the other parts of this machine, running by hand or horse power."

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9. For an *Improvement in Saw Gates;* Oliver B. Judd, Rockton, Herkimer county, New York, October 1.

Claim.—"What I claim as my invention, is raising and lowering the saw for the purpose of using the whole cutting part of the same."

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10. For *Improvements in Dash Boards for Carriages;* Lewis Lupton, Winchester, Virginia, October 1.

Claim.—"I claim the arrangement of the winch-shaped hand and foot lever, in combination with, and the attaching the same to, a jointed, moving, dash frame. Together also, with the attaching of said jointed, moving, dash frame to the running gear part of the vehicle, instead of to the body part of the vehicle, as is usual."

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11. For *Use of Rosin Oil in Printers' Ink;* Moses M. Mathews, Rochester, New York, October 1.

Claim.—"What I claim as my invention, is the employment of rosin oil in the manufacture of printing ink, substantially as set forth."

12. For *Improvements in Weavers' Shuttles;* William Murkland and Joseph Milnes, Lowell, Massachusetts, October 1.

"The first part of our invention consists in the arrangement and position of the lever forming one of the friction surfaces, by which arrangement, the irregular strain upon the yarn caused in ordinary shuttles, is to a great degree avoided.

"The second part of our invention consists in the construction and peculiar combination of the spring, which compresses the metallic friction surfaces upon the yarn."

Claim.—"What we claim is, 1st, the combination and arrangement of friction levers in weavers' shuttles, in such a manner that the lever shall be allowed to vibrate towards and from the bobbin, for the purpose of producing a more even tension, substantially as herein described.

"2d, The combination and arrangement of a spring and cam surface upon the friction lever, in order, that as the friction lever is raised from its seat, the compression may be made more or less as desired, substantially as herein described."

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13. For an *Improved Auger Handle;* Gelston Sanford, Ellenville, Ulster county, New York, October 1.

Claim.—"What I claim as new, is securing augers and other tools in their handles by means of a tube attached to the inner half of one part, and an eccentric attached to the inner half of the other part of the handle, the eccentric part passing into the tube, and the eccentric fitting into the dove-tailed grooved slot of the shank, substantially as described."

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14. For an *Improvement in Spring Callipers;* William W. Smith, Boston, Massachusetts, October 1.

Claim.—"What I claim as my improvement, is the circular spring, enclosed within the hollow head resting on the pivot, on which the two parts turn, and acting on the two parts, (or shanks), throwing them outward against the nut on the cross bar."

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15. For an *Improvement in Grain Driers;* Charles S. Snead, Louisville, Kentucky, October 1.

"The nature of my invention consists of a series of annular troughs, arranged one above another; the bottoms of the troughs are of concave form and double, having a steam space between the inner and outer casing; the steam spaces around the troughs are connected with each other by pipes or passages, so that steam admitted by a pipe into one steam space will pass around all the troughs in succession; a vertical drum or barrel is made to rotate within the centre of the annular troughs; this drum carries a number of scrapers fitting in the troughs.

"The meal or grain is fed into the troughs by a hopper or other convenient arrangement, and being kept in motion by the scrapers, is passed on through the heated troughs, falling through proper apertures from each trough, to the trough below it, by which the moisture is entirely evaporated from it, and it may be kept perfectly sweet for a very long time, in any climate."

Claim.—"What I claim as new, is the revolving barrel, consisting of the wheels, and the bars provided with arms carrying scrapers, in combination with the troughs, arranged one above another in the manner substantially as herein set forth, for the purpose of drying meal, grain, &c."

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16. For an *Improvement in the Construction of Endless Aprons in Threshing Machines and Grain Cleaners;* Ashley Townsend, Pavilion, Genesee county, New York, October 1.

Claim.—"What I claim as my invention, is the method of constructing the closed metallic apron, for separating grain in the manner described."

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17. For an *Improved Door Spring;* Amos Westcott, Syracuse, New York, October 1.

Claim.—"What I claim as my invention, is the door spring, consisting essentially of a spring, jointed lever, strap and curved track; the latter being of the form described to con-

trol the action of the spring, and the several parts, together with the door and door-frame, being arranged with respect to each other, substantially as described."

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18. For an *Improvement in Straw Cutters;* Isaac Woodward, Mechanicsburgh, Champaign county, Ohio, October 1.

Claim.—"What I claim as my invention, is the combination of the moving cleansing bar with the stationary blade, substantially in the manner, and for the purpose set forth.

"I also claim the treadles constructed and arranged, substantially as set forth in combination with the cutter gate."

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19. For an *Improvement in Shanks of Hay Forks;* David Anthony, Sr., Spring Port, Cayuga county, New York, October 8.

"My improvement consists in making the tines, and ferrule to receive them, in a way and manner, so that either of the tines may be detached, if necessary, and another put in its place."

Claim.—"What I claim as my invention, is the constructing the hay, straw, and manure forks, with two or more tines in a separate manner, and confined in a socket, as set forth in the above specification and drawings, or otherwise substantially the same, in a way and manner, so that either of the tines can be taken out of the socket, and another put in its place, if necessary."

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20. For a *Compound for Imparting a Gloss to Clothes;* William D. Beaumont, Baltimore, Maryland, October 8; anté dated July 26, 1850.

"The nature of this composition, or compound, consists in the use of stearic acid, white wax, oil of sassafras, and spermaceti, combined in such quantities, and dissolved by gradual heat, so as to produce, when cooled, a polish, in the form of cakes or bars, to be used with the ordinary starch, in small quantities, which has the effect of imparting to the shirts, linens and other fabrics thus starched a beautiful gloss, and smooth surface, similar to that produced by the process of sizing and ironing linens in the roll, and also prevents the sad iron from adhering thereto when ironing the same, and also prevents the dust floating in the atmosphere from sticking to the linens after ironed for use."

Claim.—"What I claim as my invention, is the within described compound of stearic acid, white wax, spermaceti, and quick lime, prepared as fully set forth."

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21. For an *Improvement in Presses for Copying Letters;* George Burnham, Philadelphia, Pennsylvania, October 8.

"My press is of the paten kind, the letter from which the copy is to be taken, and the book or paper, which is to receive the impression being placed between two metallic plates, which are to be drawn together when the impression is to be taken; but I have so arranged and combined the pressing plates and the other parts of the apparatus, as to render the press much more pleasant in its action than those generally used, and much less liable to the failure of its parts."

Claim.—"What I claim therein as new, is the manner in which I have arranged and combined the two plates or platens, A and B, with the two levers E E, and with the steel spring C C, as set forth; the two plates being made to approach each other by the drawing apart of the levers E E. The two bolts D D, that are operated on by said levers, passing through the outer ends of the spring C, which is curved, and operates on the curved bottom of the plate B, in the manner and for the purpose set forth."

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22. For an *Improvement in Hay Forks;* Alinzor Clark, Southfield, Richmond county, New York, October 8.

"The nature of my invention consists in an improved mode of inserting and securing the tines in the stock or handle of the fork, by which the same fork can be used as a two-tined or a three-tined fork according to the nature of the work to be performed; two tines being better suited for some descriptions of work, and three tines for others."

Claim.—"What I claim as new in my invention, is the manner substantially as herein described of forming the tines C C, and fitting them in the stock or handles, so that they

can be secured in the stock or handle, either by the wedge shank *d*, of the centre tine D, or by a detached wedge *d'* of similar form, and the pin *b;* so as to make either a two tined, or a three-tined fork."

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23. For an *Improvement in Seed Planters;* David Eberly, Strasburgh, Lancaster county, Pennsylvania, October 8.

"The nature of my invention, is the attachment of the hoppers (with pulleys at the sides having 36 cup-holes as sowers) to the top of the shovels, and by an endless cord or rope around the pulleys and the axle of the carriage, the shovels, hoppers, &c., are drawn along, and the seeding is regulated; and having a lever bar and slider attached to the double tree, the shovels are raised simultaneously, and the feed stopped, whenever required, by the pulling of the horses."

Claim.—"What I claim is, 1st, the sliding link in combination with the lever, the catch for working the seeding apparatus by the draught of the team, as set forth.

"2d, I claim stopping the feeding by slackening the bands, and the simultaneous elevation of the shovels by the draught of the team, substantially as set forth."

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24. For an *Improved Seeding Apparatus for a Seed Planter;* Gervis S. Gardner, assignor to Gervis S. Gardner and George Rohr, Charlestown, Jefferson county, Virginia, October 8.

"The nature of my improvement consists in my using in combination with an outside or wheel frame, another frame, which I term a secondary or inside hopper frame, having a centre brace beam, or stay. This inside frame works on hinge bolts or pins, so as to be elevated or depressed at pleasure, and in order to throw seeding apparatus and drill spouts off the ground simultaneously if necessary. To this inside frame I attach a longitudinal form of hopper; and also attach thereto, the drill spouts and other apparatus.

"I also use a succession of vertically arranged ratchet-shape wheels, attached to an axle running parallel with the hopper or seeding fountain, and which wheels I designate as feeding wheels, which work or revolve vertically, and partly inside of bottom of hopper; each wheel opposite a drill spout."

Claim.—"What I claim as my invention, is the ratchet-shaped vertically revolving feeding wheels, arranged and operated in the manner, and for the purpose herein set forth."

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25. For an *Improvement in Mounting the Cutters of a Mowing Machine;* George Hart, Dillsborough, Dearborn county, Indiana, October 8.

"The object of my invention, is to construct a grass or grain cutter which shall adapt itself to the varying surface of the ground; this I do by placing a series of scythes or cutters in the perimeter of a wheel or disk which is hung at the centre by a universal joint, and is adjustable to any required height by a quadrant lever, which, actuated by an arm or treadle at the will of the operator, raises the wheel shaft vertically from the ground."

Claim.—"What I claim therein as new, is the method of constructing a revolving, grass or grain cutter, so as to adapt itself to the varying surface of the ground, by means of hanging it by a universal joint on the end of a shaft adjustable vertically, substantially as herein described."

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26. For an *Improvment in Machinery for Doubling and Twisting Yarn;* Moses Hey, Springfield, Delaware county, Pennsylvania, October 8.

"My machine is constructed either to double yarns without any more twist than is necessary to keep the strands of the double yarn together, or to give it a greater amount of twist as may be desired; it is also constructed in such manner, that when the yarn of any one spindle breaks, or runs out the machine will stop itself."

Claim.—"What I claim therein as new, is the stop wires, so constructed and connected with the head of the spindle and with the strands of the yarn, that whenever any of the latter are broken or run out, the stop wires shall move and effect the disconnexion of the machinery from the moving power, thereby stopping it, substantially as herein set forth."

27. For an *Improved Kettle for Manufacturing Comfits;* William H. Holt, Hartford, Connecticut, October 8.

Claim.—"What I claim as my invention, is the improvement in the manufacture of comfits by apparatus constructed upon the principle herein set forth, and consisting essentially of a pan moved by machinery, as herein described."

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28. For an *Improvement in Gas Meters;* T. W. Lane, Woburn, Middlesex county, Massachusetts, October 8.

Claim.—"I claim the introduction of the secondary shaft, connecting by means of a wheel and pinion with the drum shaft in the interior of the meter case.

"2d, The arrangement substantially as shown, by which the gas is passed at once into the interior of the drum, and removing the pressure from the chamber in which is the valve float, or by whatever means this effect is produced."

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29. For an *Improved Eaves Trough and Gutter Machine;* John Lee, Wellsville, Columbiana county, Ohio, October 8.

"The object of my invention, is to facilitate the manufacture of tin gutters, or eavestroughs, by the use of a machine which bends the tin plates to the proper shape, and holds them while they are soldered together, in long lengths; and admits of quickly detaching and removing the work when finished, without the necessity of slipping it off endways. The machine also admits of turning the work for the convenience of soldering, while the tin is held firmly to the mandrel."

Claim.—"What I claim as my invention, is the grooved, movable rib, locking down to the mandrel for the purpose of holding the beaded edges of the sheets while bending and soldering, and rising to allow of inserting and removing the work, substantially as described.

"I also claim, in combination with the revolving mandrel, the piece suspended on the journals of the mandrel, and resting when required on the ledge, substantially in the manner, and for the purposes described."

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30. For a *Grain and Maize Harvester;* Edmund Quincy, Lacon, Marshall county, Illinois, October 8.

"The nature of my invention consists in a set of metallic fingers or knives (concave, flat, or fluted, and may be straight, or curved in the direction of their motion) arranged radially upon a revolving shaft, in such a manner or distance apart as to allow the straw, stems or stalks of grain to pass between them until the heads, ears, or seed, coming in contact with the fingers, are cut off by them, and thrown into the elevators, which also revolve as the shafts, and are carried by the elevators into an inclined spout, from which it falls into a wagon by the side of the machine, or other proper receptacle."

Claim.—"What I claim as my invention, is the use of the revolving shaft, in combination with a system of fingers, teeth, or knives arranged on the shaft as described, and for the purpose herein set forth, not confining myself to any particular size, shape, or curvature."

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31. For an *Improved Vulcanized India Rubber Spring;* Fowler M. Ray, City of New York, October 8.

Claim.—"What I claim as my invention, is the employment of a ring, or rings, or disks, made of any of the preparations of caoutchouc, known under the various appellations of metallic or vulcanized rubber, as a substitute for metal, or other kinds of springs, heretofore known and used, when such ring or rings, or disk or disks, or the equivalents thereof, are applied in manner substantially as herein described, in combination with a series of solid disks or plates, or their equivalents substantially as herein described, whether made of metal, or other solid or non-elastic substance.

"I also claim making the surfaces of all or either of the plates above and below, and interposed between the elastic rings or their equivalents, or the surfaces of the elastic rings, or either of them, convex, substantially in the manner and for the purpose specified."

32. For an *Improvement in Sofa Bedsteads;* Russell Scarritt, St. Louis, Missouri, October 8.

Claim.—"What I claim as my invention, is the combination of the frames, which are of the same form as the sofa-ends, with the said sofa-ends, substantially in the manner, and for the purpose as herein set forth; to wit, when the back is elevated, to convert the sofa-bed into a sofa, the frames must be swung inward against the sofa back to retain it in an elevated position, and to throw the said frames out of the way, and out of sight; and when it is desired to change the sofa-bed from a sofa to a bed, the said frames can only be swung outwards into a line with the sofa ends, so that the ledges, on the inner sides of the same, will unerringly catch and retain the back when it reaches a horizontal position as it is thrown rearwards: in which position, the sofa ends, and the swinging frames will form an ornamental and uniform head and foot to the bed-form of my improved sofa-bed."

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33. For an *Improved Gummet Strap;* Eli F. Southward, Wellfleet, Barnstable county, Massachusetts, October 8.

"The nature and operation of this strap is such that, by its use, the rope is secured to the sail by being strapped thereto by the leather in a manner altogether new, and the rope, and canvas, and ties are better protected from chafing than in any other mode now in use; a firmer foundation is thereby afforded to the grummet, rendering it more durable, and enabling the sail to bear a much greater strain without tearing away."

Claim.—"What I claim as new in this invention, is the mode of applying the above described strap, by encircling the rope therewith, and stitching or pegging the strap to the canvas, and so applying it as to insert the grummet through the strap and canvas."

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34. For an *Improved Spring Grapple;* Orra Warner and Charles S. Gaylord, Gaylord's Bridge, Litchfield county, Connecticut, October 8.

"Having thus fully described our invention, we will now proceed to state what we claim as our invention, but we would first say that we are aware that spring hooks or talons and a set joint have heretofore been employed as a trap, for which device letters patent were granted to Thos. A. Davies, in 1849; but his arrangement involves the use of a trigger to operate the joint,—our arrangement simplifies the trap in other respects, and does away with the use of a trigger."

Claim.—"What we claim, therefore, is not a set joint, but the arrangement of the tongs-shaped spring talons and set joint, constructed and acting as herein described."

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35. For an *Improvement in Cast Iron Car Wheels;* Nathan Washburn, Worcester, Massachusetts, October 8.

"My improvements consist in the manner of disposing of the metal in the wheel, so as to produce great strength and relieve the wheel from strain when cast and properly chilled, thus avoiding most of the defects to which ordinary wheels are liable when cast whole."

Claim.—"What I claim therein as my invention, is the combination of the arch at the centre with the curved plate and arms or brackets connecting the hub and rim, in the manner and for the purpose set forth."

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36. For an *Improvement in the Adjustment of Knives in Straw Cutters;* Joseph W. Webb, assignor to Benj. Gould, Aurora, Cayuga county, New York, October 8.

Claim.—"What I claim as my invention, is the mode of attaching the knives to the permanent arms, by means of the pendulous or movable arms rotating on the shaft, and secured to the permanent arms by means of screw bolts passing through elongated holes in the movable arms, thereby allowing the cutting edge of the knives to be placed at any required angle necessary for adjusting them to the bed cutter or shear, in combination with the movable box for regulating the mash of the cog of the pinion into those of the wheel, substantially as described."

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37. For an *Improvement in Portable Bedsteads and Sacking Bottoms;* Samuel Whitmarsh, Northampton, Hampshire county, Massachusetts, October 8.

"The object of my invention is to make a bed and bedstead which can be folded up in a small compass, and which, when stretched out, shall be of abundant capacity and strength,

and upon which a person may lie with comfort. The bed consists simply of a piece of canvas, bound round the edges to give it the required strength, and provided with hooks or loops at proper distances apart to hang it to the posts of a frame. And this, the first part of my invention, consists in inserting gores for the swell of the body at the hips and shoulders, in a cloth to be stretched to form a bed, in whatever manner the same may be hung or stretched. In this way a bed can be made of a piece of stretched canvas which will adapt itself to the form of the body, instead of having nearly the whole weight of the body resting on the hips and shoulders.

"And the second part of my invention, which relates to the method of making portable bedsteads, consists of a series of short posts of wood, or other stiff substance, adapted with vertical grooves or fillets to receive sliding blocks, when these are combined by means of a series of connecting braces on the principle of the lazy-tongs, one set of these braces being arranged longitudinally at each side, and extending from post to post, the lower end of each brace being jointed to the lower end of the posts, and their upper ends to the sliding blocks, so that by sliding down the blocks, the posts shall be separated and braced longitudinally, and, by sliding them up, drawn together; and the posts of the two opposite sides are in turn and in like manner connected together by a series of such braces."

Claim.—"What I claim as my invention in the making of a sacking bed of canvas or other cloth, to be suspended from the edges, is the insertion of gores to fit the same to the swell of the body at the shoulders and hips, substantially as described.

"And I also claim making the frame of a portable bedstead, substantially as herein described, of a series of posts connected and combined together longitudinally and laterally by braces, on the principle of the lazy-tongs, the said braces being connected with the posts by means of joints and slides, substantially as herein described."

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38. For an *Improvement in Warm Air Registers;* Peter G. Woodside, Philadelphia, Pennsylvania, October 8.

"The nature of my improvement consists in making such an opening and closing motion to the valves of warm air registers that they may remain in any position they may be left, without the fear of closing or opening by the fluctuations of the current of warm air passing through the register."

Claim.—"I do not wish it to be understood that I claim to be the inventor of screw-racks or segments of pinions, or of the particular shape or form of the register, or of the manner in which the valves are hung, or of the ornamental front, or the head or button for turning the screw by; but what I do claim as my invention, is the manner in which I have combined the screw-racks, and segments of pinions, and the application of this combination to the purpose herein described, namely, that of opening and closing the valves of warm air registers."

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39. For an *Improvement in Looms for Weaving Figured Goods;* Avery Babbett, Auburn, Cayuga county, New York, October 8.

"The first part of my invention relates to the working of the series of shuttle-boxes. I work the entire series by means of motion communicated to it through and from a single rotating shaft, which revolves with a speed equal to one-half, or less than one-half, but never greater than one-half, of the speed with which the shaft that moves the lay revolves, the shaft that works the shuttle-boxes varying in speed according to the kind of goods required to be made.

"The next part of my invention relates to the throwing of the shuttles, and to the regulation of their throwing. I throw the shuttles by means of motion communicated to them through and from either one rotating shaft, or two rotating shafts, (and if two, parallel to each other and revolving in opposite directions with equal velocities,) revolving with a speed equal to that with which the shaft that moves the lay revolves. And I regulate the throwing of the shuttles as required by the kind of goods to be made, by causing either the one rotating shaft, or the two rotating shafts, to slide, so that the shuttles shall be driven regularly from either side as required.

"The next part of my invention relates to the positive taking up of the cloth. I take it up by means of friction rolls, which have a regular and positive motion, and around which the cloth moves, and I combine with these rolls a compensating lever, which operates so as to drive the cloth beam more slowly as the roll of cloth on it increases in diameter.

"The next part of my invention consists in a positive let-off motion, whereby I effect a regular and uniform delivery from the yarn beam, of a certain and invariably equal length of yarn at each regular and uniform delivery.

"The next part of my invention consists in preventing the opening and closing of the shed from producing an increased or diminished strain upon the warp threads. This I effect by the regular and positive advance of the let-off rolls towards the harness through an invariably equal distance at every opening of the shed, and by their return through the same distance at every closing of the shed, as hereinafter described.

"The next part of my invention relates to the working of the lay to beat up the cloth. I work it by means of slides and connecting rods or pitmans, as hereinafter described. The peculiar feature of my slide is that it is worked by means of a combination of machinery, consisting of a shaft, a crank, a crank pin, a pulley, and a slot. The motion of the slide is communicated to the lay by means of connecting rods or pitmans, which are attached to the framework of the lay, and are so arranged as to brace the framework of the lay.

"The next part of my invention relates to the throwing of the loom out of gear. I cause it to throw itself out of gear whenever a shuttle fails to go into its proper box at the proper time, and also whenever the connexion formed by any weft thread between its shuttle and the cloth is not maintained during the whole time of the passage of that shuttle through the warp threads; and this I effect by the operation of hooks attached to the bed of the lay, as hereinafter described. In the arrangement for stopping the loom, when the connexion of the weft thread is broken, the hooks are combined with wires or prongs for the reception of the weft thread, as hereinafter described, and are operated by the passage of the shuttle into the shuttle-box, as hereinafter described.

"The next part of my invention consists of a conditional let-off, whereby yarn is let off from the yarn beam in consequence of there being an improper strain on the warp thread, and whereby such letting off of yarn ceases whenever the proper strain on the warp threads is restored.

"The next part of my invention relates to the working of the draft boards, (or combs where they are used,) by forming and breaking the connexion between the draft boards, or combs, and the machinery that works them, by means of the two hooks, as hereinafter described. And, in connexion with the movement hereafter described, of the part of the jacquard machine to which the harness is attached, I use, for the purpose of moving the draft boards in correspondence with the movement of the part of the jacquard to which the harness is attached, the combination of machinery hereinafter described, consisting of the two jacks, the two rods, the slide, and the pin.

"The next part of my invention relates to the movement of the jacquard machine. I attach the harness to the knot boards, (or to their equivalent, being a part of the jacquard machine,) as hereinafter described, and I then move the part of the jacquard to which the harness is attached, regularly and statedly in correspondence with the beating up of the lay, so as to aid in opening and closing the shed, as hereinafter described. And the harness, the moving parts of the jacquard, and their connexions with the lower part of the loom, are so arranged that when the loom is to be thrown out of gear, the weight of the harness, and of these parts and connexions, opposes the greatest possible resistance to the momentum of the loom. The whole of that weight rests on the two levers, and through these levers and the two pulleys on the two cams. When the lay is back, (at which time, if at all, the loom is to be thrown out of gear,) that weight rests on the parts of the two cams that are nearest to the shaft, and therefore opposes the greatest possible resistance to the momentum of the loom. I also use, as a part of the jacquard machine, and for the purpose of permitting the draft boards to come down without crowding out the cylinder or prism, the combination of machinery hereinafter described, consisting of the two slides, the two springs, and the two needles."

Claim.—"What I claim to have invented, is, 1st, the arrangement of the machinery for throwing the shuttles, as herein described, in connexion with the arrangement of machinery for raising and lowering the shuttle-boxes; the devices thus arranged occupying the under part of the loom frame, and being more simple, compact, and convenient than other arrangements heretofore in use for the same purpose.

"2d, The winding of the cloth round the beam with uniform tension, by increasing the leverage of the tension weight, in proportion as the diameter of the roll of cloth is increased, substantially as herein described.

"3d, In combination with a positive let-off, I claim the use of a conditional let-off, constructed substantially as herein described, whereby, when there is an excess of strain on the warp threads, an increased quantity of yarn is delivered from the yarn beam; such conditional increased delivery of the yarn ceasing whenever the proper strain on the warp thread is restored.

"4th, The preventing the opening and closing of the shed from producing an increased or diminished strain upon the warp threads, by means of the regular and positive advance

of the let-off rolls toward the harness, through an invariably equal distance at every opening of the shed, and by their return through the same distance at every closing of the shed, substantially as described.

"5th, The causing the loom to throw itself out of gear whenever a shuttle fails to go into its proper box at the proper time, and whenever the connexion formed by any weft thread, between its shuttle and the cloth, is not maintained during the whole time of the passage of that shuttle through the warp thread, by the operation of the hooks combined with each other, and attached to the bed of the lay, substantially as described, the hooks being, in the latter case, combined with wires or prongs for the reception of the weft threads, substantially as described, and operated by the passage of the shuttle into the shuttle-box, substantially as described.

"6th, Forming and breaking, in any required order, the connexion between the draft boards respectively, and the machinery that works them, by means substantially as are herein described; this method of working the draft boards admitting of a more simple, compact, and convenient arrangement of the machinery than others before used to attain the same end.

"7th, The combination of a rising and falling jacquard frame with the draft boards, substantially as herein set forth; whereby the depression of the frame will be simultaneous with the elevation of a part of the draft boards, and the elevation of the frame with the depression of a part; the one in this manner aiding in working and equipoising the other.

"8th, Elevating and depressing the harness and draft boards, by the simultaneous elevation or depression of all the knot boards, for the purpose of opening the sheds in looms for weaving figured fabrics, when these knot boards are arranged above the draft boards, as herein described.

"9th, In connexion with the movement of the part of the jacquard to which the harness is attached, substantially as described, I claim the arrangement of the harness, and of the jacquard, and of their connexions with the lower part of the loom, substantially as described, in such manner that, at the time when the loom is to be thrown out of gear, the weight of the harness, and of those parts and connexions, shall oppose the greatest possible resistance to the momentum of the loom.

"10th, I claim the use, as a part of the jacquard machine, of the combination of machinery hereinbefore described, as shown in fig. 4 of the accompanying drawings, such combination consisting of the two slides, the two springs, and the two needles, constructed substantially as described, and operating so as to permit the draft board to come down without crowding out the cylinder or prism, substantially as described."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Resin and Water Gas. By Andrew Fife, M. D., *Professor of Chemistry, King's College University, Aberdeen.**

Continued from page 275.

In this trial, the gas being of specific gravity 574, a foot would weigh 307 grains, and, therefore, in all 13,530 grains. The resin used was 35,000 grains, consequently the loss amounted to nearly $\frac{3}{8}$ths. There was no distillation of volatile oil, the loss must, therefore, have been occasioned by the deposit of carbon; and as the loss was as great as when the other apparatus was used, and as the gas afforded was inferior in quantity and quality, I conclude that my own apparatus was equally good with it for the decomposition of resin. The composition of resin is 10 atoms carbon, 7 hydrogen, and 1 oxygen; the compound atom weighing 75, to that of hydrogen as 1. When decomposed by heat, were each atom of hydrogen to unite with an atom of carbon, they should yield 49 of olifiant of specific gravity 976. Resin, therefore, cannot af-

* From the London Mining Journal, No. 781.

ford beyond 65 per cent.—say $\frac{2}{3}$ of its weight of heavy hydro-carbon gas, with perhaps the addition of a small quantity of carbonic oxide, and carbonic acid. But the gas afforded by the decomposition of resin, in the trials now recorded, even though it contained corbonic acid, was never of greater specific gravity than 657; there must, therefore, have been a large amount of light hydro-carbon, or a considerable quantity of uncombined hydrogen in it. It is in this way that we can account for the loss, even when there is no volatile oil distilled over. Each atom of light hydro-carbon gas that is formed, leaves an atom of carbon uncombined, because the hydrogen, in this case, takes up only half the quantity of carbon that it does when it unites with it to form olifiant gas. When any of the hydrogen escapes uncombined, then two atoms of carbon are left for each atom of hydrogen evolved; and as the weight of the carbon atom is 6 compared to that of hydrogen as 1, we observe why the loss is so great when an escape of light hydro-carbon, and especially of free hydrogen takes place. Most probably there is not much escape of free hydrogen, the gas evolved, independent of carbonic oxide and carbonic acid, consisting chiefly of olifiant and light hydro-carbon. The olifiant in the trials now mentioned amounted to 8 per cent., the carbonic acid to about 6 per cent., leaving about 86 for the light hydro-carbon, or upwards of 10 times the volume of the olifiant. Let us take a more favorable view of the case, and suppose that the light hydro-carbon is only six times the volume of the olifiant; then one atom of the hydrogen will take one of carbon to form olifiant, while the remaining six of hydrogen will take only three of carbon, thus leaving six of carbon, and allowing that the one of oxygen will unite with one of carbon, to form carbonic oxide, and which is the utmost that it can unite with, then there will remain five of the carbon in the retort. This amounts to 40 per cent. of the weight of the resin. I do not give this as what really occurs, but merely to show that there must be a great loss by the *present mode of decomposition*, and how we can account for the loss? Hence it is that we do not get so much gas as we should expect. I have said that the quantity may be considered to be from about 8 to 10 feet per pound. In the trials made by Professor Daniell the quantity did not exceed 9 feet, and the perfection of his apparatus is admitted by all.

The deposit of carbon, to which I have now referred, is a source of very great inconvenience, from its choaking up the retort, and preventing the proper decomposition of the resin. Hence the necessity of frequently cleaning out the retorts.

In the instance to which I have referred, in preparing the gas according to Mr. White's plan, it was recommended, with the view of getting the resin to be more easily melted, and, when melted, to flow more easily into the retort, that it should be mixed with refuse from the kitchen, such as waste pieces of fat and dripping, &c., all which, being, as it was said, of no value, would increase the quantity of gas, and thus lessen the price of the raw material. I presume that no one will admit the truth of this statement. Cooks generally require all the waste fat and dripping they can get; and if these be removed, something else must be supplied, perhaps at a greater price. In manufacturing the gas with Mr. White's apparatus, to which I have referred, this practice was almost

always followed. I was, therefore, anxious to test the quality of the gas thus afforded, and was kindly permitted by the proprietor to do so. In the trial the resin retort only was used, and the individual in the custom of manufacturing the gas had charge of the heating, &c.; $2\frac{3}{4}$ lbs. of resin and $2\frac{3}{4}$ lbs. of tallow were employed. After being cautiously melted and thoroughly mixed, the liquid was decomposed in the usual way, and afforded 43 ft. of gas of specific gravity 716—that is, 7·8 ft. per lb. It contained 8 per cent. of carbonic acid. The condensation by chlorine amounted to 13·25. The durability with the jet and 5-inch flame was 54′—that is, 1·1 foot per hour. With the jet the light was that of 1·4 candles per foot. Giving it the advantage of the argand, the light would, perhaps, have been about that of 2·5 candles per foot. This gas, the specific gravity of which was 716, weighed, therefore, in all 16·500 grs. The resin and tallow together weighed 38,500 grs. The loss was, therefore, nearly one-half of the materials employed in its manufacture.

Similar trials were made with oil alone, with my own apparatus, the retort having been brought to the usual degree of heat: $6\frac{1}{2}$ lbs. of oil yielded 51 cubic feet of gas of specific gravity 806—that is, 7·8 ft. per lb.; with the jet, the durability was 68′ 20″—that is, 0·87 of a foot per hour. It contained 6 per cent. of carbonic acid. By the jet the illuminating power was 3·75 candles per foot; by the argand, 5·6 candles per foot. The gas being of specific gravity 806, and 51 ft. from $6\frac{1}{2}$ lbs., the loss was upwards of one-half of the material employed in its manufacture.

It is generally allowed that, by cautiously conducted trials, a gallon of oil will yield about 100 ft. of gas; but this is seldom obtained in practice, unless when the gas is of inferior quality; for, it is well known that, by a particular mode of decomposition, a large quantity of poor gas may be procured. I have seen oil gas of specific gravity 940. That referred to by Dr. Henry, in his trials with it, was 906. In numerous trials which I made, many years ago, at the oil gas works at Leith, and also with a small apparatus erected for lighting a manufactory in Edinburgh, I did not find the specific gravity to be beyond 710. In some instances it was only 645. The gas of specific gravity 710, was at the time considered to be of good quality. The condensation by chlorine amounted to 32 per cent. The quantity of gas obtained from a given weight of oil was not ascertained, but let us suppose that it came up to the full allowance—that is 100 feet from a gallon, then the loss amounted to nearly one-half. Taking the gas of specific gravity 906, there must have been a loss of about one-third, supposing that 100 ft. were procured from the gallon; but of this I have my doubts. I am inclined to think that in *practice*, there is in the conversion of oil to gas, a loss of about one-half; and that, therefore, in the trials which I have recorded, the loss was not greater than that which usually occurs. If it be thus with oil, I suspect it will be found to be at least to that extent with resin. In Mr. White's statement 10,000 feet of gas are got from 6 cwts. of resin, with an additional quantity of water. It is understood that Mr. White's gas contains about equal volumes of resin gas and of water gas, very frequently more of the latter; therefore, from the 672 lbs. of resin, about 5000 feet of gas are got—that is, 7·4 feet from the pound. The gas

is said to be of the specific gravity 924, if so, the loss is nearly one-half. If we take the appended statement—viz., that the quantity of resin used was upwards of 7 cwts., then the loss must have been much greater.

I come now to consider the quality of the water resin gas, or, as it is very improperly called, the hydro-carbon gas, and its value for the purposes of illumination. This gas is generated by the decomposition of water and of resin in separate retorts; the former being decomposed by heat, the latter by heat with the aid of carbon and of iron. If what I have already said be correct, it is evident that the gas thus produced is merely a mixture of resin gas—that is of a gas resembling coal gas in its composition—and of hydrogen, with variable proportions of carbonic oxide and carbonic acid, according as the water is decomposed. I regret that I cannot give the results of the manufacture of the gas by the apparatus erected under the superintendence of Mr. White, as I fully expected to have been able to do. In the different attempts which I made to ascertain the quality of the gas manufactured by that apparatus, several circumstances occurred to prevent me from arriving at the truth. In the first trial I found the gas of high illuminating power, but it was afterwards ascertained that tallow was mixed with the resin; in what proportion I did not hear. At my next visit the gas was made by using both retorts, employing resin for the one, and water for the other; but it was afterwards discovered that the water retort was not in action, consequently, the gas collected was entirely that from the decomposed resin, or a mixture of resin and tallow. I was obliged, therefore, at that time, to give up the attempt, not from any unwillingness on the part of the proprietor, for he was extremely anxious to ascertain the truth, but from the difficulty of getting the apparatus into proper working condition, though it had been erected for a very short time. This put a stop to future proceedings. I do not, however, consider this of great consequence. I have ascertained the quality of resin gas, of gas from mixture of resin and tallow, and of water gas, *separately*, and as these, by Mr. White's process, are generated in separate retorts, we must consider the gas thrown into the gasometer to be merely a *mixture* of those mentioned, in variable proportions, according to the proportions of the articles employed in their manufacture, and the rapidity with which the one and other is decomposed. We can thus arrive at the quality of the hydro-carbon gas, as it is called, and its consequent expense for the purposes of illumination, as compared with other sources of light, as, for instance, with coal gas.

I have already said, that as resin is composed of C 10, H 7, O 1, the utmost that it can yield of olifiant is 49; of light hydro-carbon, about 28 from 75 of resin—that is, about 64 per cent. of the former, and about 37 per cent. of the latter. But resin never yields olifiant only: independent of carbonic acid and oxide, the gas is a mixture of olifiant and light hydro-carbon, with perhaps a slight admixture of uncombined hydrogen. I have shown that the gas, when it contains about 6 per cent. of carbonic acid, varies in specific gravity from about 570 to 660. I have never found the condensation by chlorine to exceed 8 per cent., thus making the composition to correspond with the specific gravity; for a gas composed of 8 of olifiant and 92 of light hydro-carbon

would be of specific gravity a little above 600. I have no doubt that resin gas, when free from carbonic acid, will be found to be of about that specific gravity. I stated the specific gravity of the water-gas, as generated by Mr. White's process, to be about 574. Supposing that it is mixed with an equal volume of resin gas, then the specific gravity ought to be about 580, or somewhere between that and 600—that is, presuming the absence of carbonic acid. Supposing the per centage of carbonic acid to be about 6, then the specific gravity would be about 630.

I must confess that I am at loss how to reconcile this with the very remarkable statement made by Mr. White in the *Gas Journal* for April last. It is there said that the gas manufactured from *resin and water* is of specific gravity 924, and contains 12½ per cent. of olifiant. A gas having 12½ per cent. of olifiant, the remainder being water gas, or light hydro-carbon, would not exceed 650 in specific gravity. His gas, therefore, must either have contained much more olifiant, indeed have been composed almost entirely of olifiant, or must have had a very large admixture of carbonic acid or carbonic oxide. Resin gas, I have said, did not in my trials contain beyond 8 per cent. of olifiant. The high specific gravity of his gas must, therefore, have been occasioned by carbonic acid or carbonic oxide, perhaps by both, the latter of which is valueless for the purpose of illumination, and the former detrimental.

With regard to the illuminating power. I have never been able to manufacture gas from *resin alone* with more than 8 per cent. of olifiant. Mr. White states that, by his improved process, he gets the gas from *resin and water* with 12½ per cent. of olifiant. How is it possible that, by the addition of resin gas to another gas of lower specific gravity and illuminating power he gets a gas of higher illuminating power and greater gravity? To me it is a puzzle. I wish much that he had entered more minutely into a description of his improved process, and had also stated his method of ascertaining the specific gravity, the illuminating power, and the per centage of olifiant.

That there is a large admixture of carbonic acid in Mr. White's gas, when he takes the specific gravity, appears certain from what he has stated in the paper referred to. He says that now there is but little carbonaceous deposit in the retort, owing to the peculiar mode of arrangement and admission of the hydrogen and carbonic oxide. Now, as by the manner of decomposing the water, oxide of iron is formed in the retort, it is evident that the whole of the oxygen of the water is not converted to carbonic oxide by its union with carbon; the specific gravity of the gas, therefore, which is evolved from the water ought to be below 522, which is that of a mixture of equal volumes of carbonic oxide and hydrogen; but suppose that it is not much below that, and that no carbonic acid is present, then to get from resin and water a gas of specific gravity 924, containing olifiant, with the residue composed of equal volumes of hydrogen and carbonic oxide, which it should be were all the oxygen disengaged as carbonic oxide, there ought to be about 87 per cent. of olifiant. Supposing that Mr. White's gas was a mixture of olifiant, carbonic acid, and water gas, which contains equal volumes of carbonic oxide and hydrogen, and that the water gas is about 522 specific gravity, and that the olifiant was 12½ per cent., then, to have it of the specific gravity 924, it should be about 12·5 olifiant, 52 water gas,

and 35 carbonic acid. Were the carbonic acid removed from this gas, the specific gravity would be a little above 600, most probably the real specific gravity of the *inflammable* gas obtained from resin and water together. With regard to the illuminating power of the water resin gas, Mr. White has stated that "it is 26·5 per cent. superior to Manchester Cannel gas, and 20·5 per cent. to the Salford Cannel gas." In my paper published in No. 1 of the *Gas Journal*, I have shown that these Cannel coal gases are nearly of the same quality, and contain 7.6 per cent. of olifiant. By the chlorine test, independent of durability, the illuminating power of Mr. White's gas, containing 12·5 of olifiant, ought to be 64 per cent., instead of 26·5 and 20·5, beyond that of the coal gases he mentions. Of course, if we take durability also into the account, the value should be greatly beyond that. The specific gravity of the Manchester gas at the time I tried it was 451. I have formerly shown that the durabilities, with the same burner, are as the square roots of the specific gravities. Taking durability into account also, the illuminating power of Mr. White's gas ought to be at least 90 per cent. greater than that of the Manchester gas.

It is evident from this, either that Mr. White's gas must be one *sui generis*, or that there is some strange inaccuracy in the mode of ascertaining the quantity, and of testing its qualities. Can it be that the quantity of gas evolved, say 10,000 feet, of specific gravity 924, from 6 cwts. of resin and 24 gallons of water, and which I have said is a mixture of olifiant, light hydro-carbon, carbonic acid, and carbonic oxide, with perhaps a little hydrogen, was the quantity indicated by the meter, immediately after the gas escaped from the retort, and was then of the specific gravity stated, and that, after it had stood over water in the gasholder for some time, and by which it would lose its carbonic acid, it then contained 12·5 of olifiant. If so, the quantity of gas valuable for the purpose of illumination must, by the abstraction of carbonic acid, be far below what Mr. White states. Be that as it may, till Mr. White describes more minutely than he has done his method for finding the quantity and quality of the gas, I must adhere to the conclusions which the trials I have now recorded warrant—viz., that the quantity and quality of gas, after being properly purified, will be found to be far inferior to what Mr. White has stated; that in all probability the quantity of gas from *resin* will in practice not exceed 8 or 9 ft. per lb.—that is, about 1000 ft. per cwt.; that the gas after being purified will be of specific gravity not much beyond 600; the condensation by chlorine not beyond 8 or 9 per cent.; a foot of it not giving more than the light of from 2½ to 3 candles. If so, then, when that gas is mixed with about its own volume of water gas, no doubt the quantity will be increased, but to the *serious deterioration of the illuminating power*. That of the water may be said to be *nil*, or a very near approach to it; consequently the reduction in the illuminating power of the other will be just in proportion to the addition; indeed, were it not that the water gas adds to the quantity, and perhaps, from the peculiar mode of generating it, also adds to the specific gravity, of which as an indication of the value, some have a high opinion, I strongly suspect that Mr. White had better dispense with it altogether, and thus save the trouble and expense of manu-

facturing, and of storing and transmitting to the public, an article which, for the purpose of illumination is, as now generated, absolutely useless.

After what has been said, I scarcely think it necessary to advance anything with regard to the expense of manufacture, and the supposed economy of water resin gas, as a source of light. If I am correct in my assertion that 1 cwt. of resin will yield 1000 feet of gas, of illuminating power equal to that of the best English caking coal gas, or of the Lancashire and Yorkshire Cannel coal gas, while the cost of the raw material for the manufacture of the former is at present 3s., and for that of the latter at Manchester is about half that sum, then there must be an enormous saving by the sale of the products of distillation to make up for the difference. While much saving must result from shortening the time, yet, to drive off the same quantity of gas, it will be found that very nearly the same amount of heat will be required, and, consequently, nearly the same consumption of fuel will be necessary. With regard to the saving from the products of distillation, I am not prepared to speak; but this is not necessary, enough has been already said, to prove the absurdity as to the value put upon them by Mr. White.

Since writing the foregoing, some papers have unexpectedly been sent to me, regarding hydro-carbon gas, containing statements, on one of which in particular I feel called on to make some remarks. Referring to the hydro-carbon gas, as *made in the neighbourhood of Aberdeen*, it is said to be "of specific gravity 936, and shows an illuminating power superior, as compared with the Aberdeen gas, of 33·1 per cent. With the chlorine test, it shows an illuminating power of 28, while the Aberdeen gas shows only 14, and its durability, burning at 7-10ths of an inch pressure, is 82·30 to 61·40 Aberdeen gas." This paragraph appeared in an Aberdeen newspaper a twelvemonth ago, and now forms part of a manifesto issued by Mr. White, dated May, 1850. The gas there alluded to was that experimented on by me, when I first visited the water resin gas apparatus erected by Mr. White. The results stated are certainly correct, in so far as they are the results obtained by me, *with the gas on which I then experimented.* I did not take any notice of this paragraph at the time, not being in the custom of replying to newspaper observations. I cannot now, however, allow it to pass unnoticed, especially as it forms a part of the "puff direct," by Mr. White, and also, as it is well known here, that the experiments were made by me. Were no allusion made to it, it may appear that I have sanctioned this statement of the very high value of the hydro-carbon gas, as proved by my experiments. With regard to the trial referred to, I have already said that I had got permission to try the quality of the water resin gas, manufactured by Mr. White's apparatus. I had expected that I should witness its preparation; but on my arrival, I found that this could not be accomplished, and was therefore obliged to *test gas previously manufactured.* I was certainly surprised at the very high specific gravity and illuminating power, and said so at the time, and expressed my desire to have another trial. It was not till afterwards that I was informed that instead of *resin only*, a *mixture of resin and tallow* was employed; in what proportions was not stated. Still, making allowance for this, I was not satisfied that these, with the addition of water gas, should afford a gas of such high

illuminating power, and I again requested to be permitted to test the quality of the gas, on condition that I should be allowed to witness the whole proceedings. This was obligingly granted. At my next visit, the retorts being heated, and being aware that it would make no difference in the quality of the gas whether the resin gas and water gas were prepared at the same time, or were manufactured the one after the other, I suggested the propriety of adopting the latter method, that I might have the opportunity of ascertaining the proportions of the gases from the different materials, more especially as I had my suspicions that the supply of water gas was deficient. The resin gas was accordingly first made. We then proceeded to the manufacture of the water gas, but *not a particle came off*. Everything was done that could be devised, but without success; we were, therefore, obliged to desist. On drawing the fire, to enable us to examine the retort, we found that it was cracked, and, consequently, the gaseous matter, if any was formed, had escaped into the fire. The gas collected in the gasholder was, therefore, not water resin gas, but that from *resin alone*.

With regard to the gas referred to in the paragraph quoted, and which is stated to be hydro-carbon gas (that is water and resin gas), I maintain that *it did not contain a particle of water gas*. It was not even resin gas; it was procured from a mixture of resin and fat;—the *latter*, I have no hesitation in saying, in *by far the largest proportion*. Strange that that gas, said to be water resin gas, should be of specific gravity 936, contain 28 of olifiant, and have durability 82′ 40″; while gas which I saw prepared by the same apparatus, from a mixture of equal parts of resin and fat, should be only of specific gravity 716, have 13·5 of olifiant, and durability only of 54′. Does not this show that I am correct in saying, that the gas thus blazoned forth as water resin gas was prepared from fat and resin only, *the former in very large proportion*.*

There is only one other circumstance to which I would advert, also stated in the papers referred to. It is often said that the most important part of a letter is contained in a postscript, and in one of the printed papers issued by Mr. White there is a P.S. which is certainly very important, because it is contradictory of a previous statement, and seems to let out the secret regarding the enormous quantity of gas obtained. He there states, "One cwt. of resin yields by my system, if *wrought up*, 2000 feet of gas or more, possessing an illuminating power 26½ per cent. superior to Manchester gas. I find it, however, more economical not to convert the whole of the resinous matter into gas;" "it may be found more profitable not to push the quantity of gas beyond 2000 feet from each cwt. of resin, although at the works erected by me at Bristol they regularly obtain 3500 to 4000 feet from the same quantity, *by fully working up the residuum*." In a P.S. it is said, "Some may not understand why I only obtain 2000 feet from each cwt. of resin, while at Bristol 3500 to 4000 feet is produced from the same quantity. This is easily explained. The gas at Southport is 26½ per cent. superior to that of Manchester; by,

* I beg distinctly to be understood, in making this remark, that I am not throwing out any reflections against Mr. White, far less against the proprietor of the apparatus, to whom I am indebted for his kind permission to test the quality of the gas. The latter was not aware of the state in which the apparatus was at the time; the former, so far as I know, knew nothing of the proceedings.

therefore, merely *adding that additional per centage of my water gas* (and they add still more at Bristol) you have about 3500 feet, equal still to Manchester gas." Here, then, the greater quantity of gas is accounted for, at one time by *working up the residuum*, at another by the *additional per centage of water gas*. Hence, from 1 cwt. of resin any quantity of gas may be got, provided an additional supply of water gas be introduced. But, then, as Mr. White properly admits, this acts injuriously on the illuminating power, consequently the less that there is of the water gas the better, in so far as light-giving is concerned. Here again, we have additional proof of what I have already advanced, derived from Mr. White's own statement. He has said that in his process the water costs *nil*. I go still farther, and maintain that the water is *nil*, not only before it goes into the retort, but also (if this word will admit of a comparative degree) that it is worse than *nil* after it escapes from it. Why, then, use it? Merely, I presume, because it *adds to the quantity*, and with some, quantity goes a great way.

On the Preparation of Green and Grey Colors from Oxide of Chromium, for Calico Printing. By Dr. W. H. De Kurrer, *of Prague.**

Greens, prepared from oxide of chromium, for cylinder printing, were first introduced into Bohemia in 1840, and soon became universally employed in printing establishments; and immediately upon their adoption came also into use the numerous tints of pearly-grey, likewise obtainable from oxide of chromium. Colors prepared from oxide of chromium possess the valuable property of resisting the action both of light and air, acids and alkalies, and may consequently be classed amongst the fast colors. In preparing these colors for printing cotton fabrics, the substances employed are principally chloride and nitrate of protoxide of chromium, and chromo-sulphate of potash or chrome alum. The chloride of chromium, called also sea-green in the Bohemian manufactories, is employed in the following manner in calico printing establishments, for the purpose of producing the green oxide of chromium. At the commencement of the process, the green hydrate of oxide of chromium is prepared by first dissolving 4 kilogrammes† of bichromate of potash in 22 litres‡ of boiling water. Then, into a boiler or vessel containing 108 litres of boiling water, 4·5 kilogrammes of pulverised white arsenic are thrown, and boiled for ten minutes; a precipitate will be formed, and must be allowed to settle; the clear liquor is then run off, and immediately mixed with the solution of bichromate of potash, stirring all the time; in a short time the mixture acquires a green tint, and the hydrated oxide of chromium will be formed and precipitated. After being several times well stirred, and allowed to cool, the whole is thrown upon a filter of white wool, and the hydrate of chromium remaining on the filter is carefully washed with boiling water. It is then dried, and is ready to be employed for the preparation of the chloride. In order to obtain the latter salt, hydrochloric acid of 22° Beaumé is diluted with water, until

* From the London Journal of Arts and Sciences for August, 1850.

† About 2 lbs. English. ‡ About a quart English.

the acid no longer gives off vapor. It is then heated, and whilst hot, as much of the hydrated oxide of chromium prepared as above is added, as will saturate the acid and leave a slight excess of the oxide undissolved. The whole is then left to settle, and the clear liquor is decanted from the undissolved matter. In this state the solution of chloride of chromium still presents some traces of free acid, which would act injuriously upon the fibres of the cotton. To remove this, and obtain the product in a neutral state, potash ley (marking 20° Beaumé) is poured in very gradually until the oxide of chromium begins to be precipitated. The solution of chloride of chromium thus prepared, and which is of a dark green color, is evaporated until it marks 46° Beaumé. After cooling, a coloring matter is obtained from it, consisting of oxide of chrome of the finest green color. This preparation is sold under the name of sea-green. Before this substance (which can be used with greater advantage than any other preparation for printing in green upon calico) was known, the following, amongst other preparations, were employed for obtaining chrome green:—

1*st Preparation.*—To a solution of 0·656 kilogrammes of bichromate of potash in 3 litres of water, add 1·406 kilogr. of hydrochloric acid, and afterwards 0·250 kilogr. of pulverized tartaric acid. By the addition of the tartaric acid the solution acquires a fine green tint, together with a sweet taste. The following proportions have been given for producing the various shades of color required:—

	kil.	kil.	kil.	kil.	kil.	kil.
Chromate of potash...	1·750	2·875	1·000	0·500	0·437	0·375
Hydrochloric acid.....	3·125	1·625	1·750	1·000	0·937	0·750
Tartaric acid.....	2·500	1·625	0·500	0·250	0·172	0·187

All these compounds (which have a slightly acid reaction) are, when used for printing, thickened with starch or wheat flour, gum tragacanth, or other gums; and, to fix the colors, the printed fabrics are, according to the tint required, kept stretched in the air for several days, and then washed; or they are passed through a bath of chalk, or of ammonia. This bath of ammonia is prepared with 24 litres of boiling water, 4 kilogr. of slacked lime, and 2 kilogr. of hydrochlorate or sulphate of ammonia, and the fabrics are submitted thereto by being passed several times through a machine similar to that used for printing ground colors; a free current of air being kept up to carry off the pungent odour of the ammonia.

2*d Preparation.*—0·500 kilogr. of bichromate of potash are boiled in 3 kilogr. of hydrochloric acid until chlorine ceases to be evolved; 0·500 kilogr. of soda, previously calcined, and 0·500 kilogr. of caustic soda ley, marking 14° Beaumé, are then added; and for printing, the liquor is thickened with gum tragacanth. The piece, when printed and dried, is passed through a boiling ammoniacal bath, composed of 0·500 kilogr. of caustic lime, 0·500 kilogr. of hydrochlorate or sulphate of ammonia, and 24 litres of water; after which, it is well washed, and finally stretched and dried.

3*d Preparation.*—To a hot solution of 0·656 kilogr. of bichromate of potash in 3 litres of water, 0·500 kilogr. of syrup are added, and afterwards, by degrees, 2 kilogr. of hydrochloric acid, marking 34° Beaumé,

which causes this liquor very shortly to assume a green tint. It is neutralized with caustic soda, the color is thickened as in the first preparation, and the printed fabric is finished in the same manner.

4th Preparation.—Nitrate of chromium is prepared by dissolving in nitric acid the green precipitate of oxide obtained by arsenic in the same manner as the chloride is prepared with hydrochloric acid. This green, thus obtained, gives a yellowish tint upon cotton fabrics.

Printing sea-green with the roller.—For cylinder printing with chloride of chromium, the color must be thickened either with gum tragacanth or starch. The following is the mode of proceeding:—

1. *Thickening with gum tragacanth.*—Take 0·220 kilogr. of gum tragacanth reduced to very fine powder, which make into a thin paste with alcohol; then cover up the vessel in which this operation is carried on, and leave it to settle for a few hours; after which, add 14·250 litres of solution of chloride of chromium, marking 46° Beaumé; leave the whole for from 24 to 36 hours, merely stirring occasionally, and finally strain it through a cloth. When the color is too thick for printing delicate designs from the cylinder, it is only necessary to add more of the solution of chloride of chromium until the desired consistence is attained.

2. *Thickening with starch.*—Mix intimately 2 kilogr. of starch with 5 litres of water; boil the mixture to the consistence of glue; let it cool, and add the solution of chloride of chromium, marking 46° Beaumé, until it is of the consistence required for printing.

As gum tragacanth is of a denser nature than starch, it furnishes bolder and more intense colors than the latter. After printing, the fabrics are stretched on a frame, and left during the night in a cool place; the next day they are treated with caustic potash ley, marking 2° Beaumé, well aired, pressed as dry as possible, and then laid for about an hour in running water, washed with washing wheels, pressed and dried, and finally submitted to the process for brightening the colors.

After fixing the yellow, green, and blue colors, by passing them through lime or by immersion in the bath of acid chromate of potash, the operation is completed; the brightest possible green is obtained by passing the fabric through a bath of acetate of copper, as a portion of the green chromate of copper then combines with the chrome green, and heightens its tone. The operation is conducted as follows:—The proper quantity of water is heated, in a suitable vessel, to a temperature of 55° or 56° Cent., 2 litres of a solution of acetate of copper are added, and the printed pieces are passed twice backwards and forwards through the liquor; they are then placed in running water; after which, the moisture is pressed out of them, and they are dried. When six pieces have been passed through the copper bath in the manner described, 2·375 kilogr. of solution of copper are added for each successive piece, and this is continued so long as there are any pieces to operate upon. The salt of copper gives to the green color a peculiar lustre, without having an injurious influence over the other colors present,—even the chrome-yellow loses none of its beauty. The acetate of copper is prepared by dissolving 20 kilogr. of sulphate of copper or blue vitriol in 72 litres of water, decomposing by 10 kilogr. of sugar of lead, and using the clear supernatant liquor.

Printing with two green colors.—When, by means of a reserve of arseniate of potash, figures dyed red or violet by madder are stopped out, and the white parts of the fabric printed by hand from a design in relief, with a solution of chloride of chromium thickened with starch or gum tragacanth, then, by afterwards printing over this with sea-green, by means of the cylinder, a dark green pattern will be obtained upon a light grey ground; and after applying the other colors requisite for completing the design, the fabric is passed through a bath of acetate of copper to brighten the greens.

Cylinder printing with yellow designs upon a green ground.—Yellow patterns upon a green ground may be produced by printing (after applying the reserve to protect the madder reds and purples) with the base of lead, and afterwards applying the chrome green with the printing roller. Fabrics thus treated are passed through milk of lime at a temperature of 38° Cent.: they are washed and dried, and then the fast blue, green, and yellow colors are printed; the fabrics are again passed through milk of lime, and after being well washed, the yellow and green colors are brought out by a bath of acid chromate of potash.

The preparation of lead for this purpose consists of the following composition:—3 kilogr. of pipe-clay are damped with 1·780 litres of water, and mixed with 3·560 kilogr. of gum water, to which is added 1·440 kilogr. of a solution of chloride of zinc. For every litre of this solution 0·150 kilogr. of acetate of lead, dissolved in a small quantity of water, is added before printing.

Chrome olive.—Very fine and fast olive colors may be obtained suitable for cylinder printing (upon which yellow patterns may be produced by acetate of lead) by means of the following preparations:—

1. *Light olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 2 litres of cachou-brown.

2. *Medium olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 2·350 litres of cachou-brown.

3. *Dark olive.*—To 12 litres of solution of chloride of chromium thickened with starch add 3·560 litres of cachou-brown.

The cachou-brown, which is added to the oxide of chromium or sea-green to form olive colors, is prepared by dissolving 2·5 kilogr. of Gambia cachou in 10 litres of water over a gentle fire, and straining the decoction through a fine sieve; 2·375 litres of this solution are then boiled with 0·155 kilogr. of starch, 0·090 kilogr. of verdigris, and 0·120 kilogr. of sal-ammoniac.

The day after printing, the olive colors may be brought to any desired shade by the following means:—

1. To produce a brown tint, the pieces are introduced into a vat furnished with a drum, and containing milk of lime, (at a temperature of 40° Cent.,) and afterwards carefully washed. 2. In order to approach nearer to an olive green, instead of milk of lime, they are passed four or five times over the drum (a single piece at a time, and in one direction only) through a bath of acid chromate of potash. 3. When it is desired to bring the above colors to a more decided green, the pieces, after having received all the colors required, viz., the yellow, the fast blue and green, and also the sea-green, are passed through a bath of acetate of copper, heated to 60° Cent.

Cylinder printing in green by means of arseniated chloride of chromium.—Shades of green may be obtained, differing somewhat from the ordinary sea-green, by the employment of arseniated chloride of chromium, prepared in the following manner:—In a large earthen vessel a mixture of 4 kilogr. of hydrochloric acid and 9 litres of water, are heated to ebullition on a sand bath; to the liquor is added 3 kilogr. of bichromate of potash. When the solution is complete, 3·650 kilogr. of finely-pulverized white arsenic are introduced in small quantities, in order that the liquor may not rise and overflow. When the arsenic is likewise completely dissolved, the solution is allowed to cool; the clear liquor, when decanted, is kept ready for use.

For immediate use 1 kilogr. of starch, and 0·060 kilogr. of finely-powdered gum tragacanth are boiled in 8 litres of water, and the mixture is allowed to cool. Into 8 litres of this thickening mixture 32 kilogr. of arseniated chloride of chromium are slowly poured, and when properly mixed, 6·5 kilogr. of potash ley of 16° Beaumé are added very gradually, stirring briskly all the time. The color appears very thin before the addition of the potash; but it is thereby thickened and rendered suitable for cylinder printing. The fabrics printed with this preparation are the next day passed through a weak potash ley, (heated to 60° Cent.,) to which a small quantity of milk of lime has been added; they are then well washed, stretched, and dried.

To produce a fast green color, approaching to grey, take 12 litres of green printing color, and 2·375 litres of fast blue, prepared from indigo, mix them together, print the fabrics therewith, and next day pass them through milk of lime; wash with clean water, and stretch and dry them as before.

In order to *impregnate* the fabric with the color by means of the cylinder machine, so as to produce a uniform green ground, mix gradually 71 litres of the solution of arseniated chloride of chromium, marking 55° Beaumé, with 6·500 kilogr. of solution of potash, of 16° Beaumé, diluted with about 15 litres of water; then add 3 kilogr. of mucilage of gum tragacanth, and 0·040 kilogr. of chloride of iron, and 0·067 kilogr. decoction of logwood, of 2° Beaumé.

Pearl-grey color for printing.—This pleasing color is obtained by means of sulphate of chromium, and of potash (chrome alum). It is prepared in the following manner:—Into four large stone vessels are severally poured 2 kilogr. syrup of sugar, and 2 kilogr. of thick gum-water, prepared by dissolving 1·50 kilogr. of gum in 1·25 litres of water. Into each vessel a hot solution of 2 kilogr. of bichromate of potash in 6 litres of water is then poured, the mixture being briskly stirred. After being allowed to cool down to 30° Cent., 2·50 kilogr. of colorless sulphuric acid diluted with water (say 2 kilogr. acid, and 3 litres water) are added, again stirring briskly. After the lapse of a short time, the liquor will become spontaneously heated, and rise rapidly. In order that no loss may arise, the liquor which may overflow should be received in another vessel. The color gradually changes from orange to olive-green, and finally to dark grey. It must be stirred from time to time until the liquor ceases to froth up, when it will be found to have acquired a fluid consistency, and a blackish-grey color. As soon as the rising ceases, that

which had overflowed is poured back again, and, when perfectly quiescent and cold, the contents of the four pots are mixed together, when the liquor will be ready for use, it being found to consist of a compound or mixture of sulphate of chromium, with sulphate of chromium and potash (chrome alum).

This color will be found well adapted for cylinder printing, which is performed in the ordinary manner of printing with starch colors, viz., by introducing a cylinder provided with a woollen band into the dye-vat, from which the color is fed to the engraved cylinder. Ten pieces of calico may be easily printed off with this color without changing the doctors, as they are not affected by it.

The next day after printing, the fabrics are stretched upon frames, and immersed during six minutes in a vat filled with milk of lime; they are then left for an hour in running water, and passed through a bath of hot water to dissolve all the reserve, in order that this may be completely washed out in the washing machine; and they are afterwards dried.

Green patterns upon a pearl-grey ground.—These may be obtained perfectly fixed by preserving the madder reds and violets with the reserve of arseniuret of potassium, then printing on the white ground the patterns in sea-green, and afterwards with the cylinder applying the pearl-grey color.

Yellow patterns on a pearl-grey ground.—These are produced with the preparation of lead, in the same manner as above described for sea-green.

Yellow, green, blue, and cachou-brown colors may be advantageously applied to the above; and in passing through a bath of milk of lime and another of yellow and neutral chromate of potash, the yellow and green will be brought out, and the cachou-brown fixed.

The bath of neutral chromate of potash, for bringing out and fixing the colors, is prepared in the following manner:—Into a vat, provided with a drum, and three parts filled with water, a solution of 3 kilogr. of neutral chromate of potash is poured, to which are added not more than from 4·750 litres to 5 litres of vinegar, in order that it may not be acid, as bichromate or acid chromate of potash would convert the pearl-grey into chromate of chromium, which is of a brownish yellow color. The yellow, to be good, should appear in the bath of neutral chromate of potash of a brimstone color,—the green having always, on the contrary, a pear-green tinge; consequently, in printing in pearl-grey, should a fine grass-green be required, a good steam color must be resorted to.

Pearl-grey, approaching to blue.—To produce this color, the sulphate of chromium and potash must be prepared as follows:—In 6 litres of water 4 kilogr. of bichromate of potash, in small pieces, are dissolved; 2·5 kilogr. of colorless sulphuric acid are diluted with 2 litres of water, and this dilute acid, when cold, is poured slowly into the solution of chromate, which is stirred; then add 2 kilogr. of powdered sugar, in small portions at a time,—which addition will cause an elevation of temperature and great effervescence. When the mixture is cold, the sulphate of chromium and potash possesses a certain degree of consistence, and, for printing, the following proportions of syrup and British gum are added as thickening matter:—1st. 2·375 litres of syrup are diluted with 2·375 litres of water, and added to 4·750 litres of solution of chrome

alum. 2d. 3 kilogr. of British gum are boiled in 3 litres of water, and after complete cooling, are poured into 4·750 litres of the solution of chrome alum. Neither dry gums nor gum water will serve as thickeners for this color, as gums contract and form with the double sulphate of chromium and potash a hard matter resembling leather. The printed fabrics are next day passed through milk of lime, and treated in the manner above mentioned. If to 12 litres of the pearl-grey about 1 litre of the cachou color, prepared in the same manner as for chrome olive, be added, a peculiar reddish-grey color will be produced.

Chrome-green printing color.—A very fine green color (suitable for printing stripes upon cotton) may be produced by preparing chloride of chromium in the following manner: 4 kilogr. of pulverized white arsenic are dissolved in 106 litres of water by the application of heat; 3·5 kilogr. of bichromate of potash are also dissolved by heat in 14 litres of water, and this solution is poured slowly (stirring continually) into the arsenious solution. After cooling, the green precipitate is thrown upon a cloth, and when well drained, 5 kilogr. of hydrochloric acid of 22° Beaumé are added to it; it is then dissolved in a sand bath and evaporated to 4° Beaumé, neutralized by means of 1·750 litres of soda ley at 20° Beaumé, stirring continually; and, finally, the liquor is thickened with 100 grammes of gum tragacanth, finely powdered;—when it will be fit for printing. The fabrics thus printed are left for 24 hours in a cool place, and then dried.

Steel green-grey steam color.—To prepare this color, which is chiefly employed for printing cotton stripes, the chrome alum is prepared as follows:—Into a solution of 7·5 kilogr. of bichromate of potash in 15 litres of water, pour slowly 4·625 kilogr. of colorless sulphuric acid, and mix gradually with the liquor 1·875 kilogr. of raw sugar. The stone vessel in which this solution is effected is kept hot in a sand bath, until the mixture has acquired an emerald-green color, when it may be left to cool.

Color for printing.—To 2·375 litres of starch paste, prepared with 0·360 kilogr. of that substance, are successively added 7·125 kilogr. of chrome alum, 9·5 kilogr. of cachou-grey, and 0·900 kilogr. of acetic acid of 3° Beaumé.

To prepare the cachou-grey, dissolve 4 kilogr. of Gambia cachou in 24 litres of wood spirit, and add 1·780 litres of gum water for each 1·780 litres of the cachou solution: the grey color is finally obtained by the addition of 0·060 kilogr. of green vitriol.

This color requires most particularly to be steamed, as the green and other steam colors, which are easily affected, would be changed by the acetic acid, which is otherwise carried off in the form of steam.

On Some Phenomena of Defective Vision. By R. T. Cranmore.*

One of the earliest evidences of old age creeping on is experienced in defective vision; and some months ago my attention was directed to a peculiarity in the phenomena attending it which I do not recollect to have seen noticed in books. It may possibly be peculiar to my own

* From the London, Edinburgh, and Dublin Philosophical Magazine, vol. xxxvi.

eyes: but I think not; for though there is a difference between my left and right, from long habit of using microscopes, still the general result is similar in each, and I think such as must be detected by other persons.

I made a small square bounded by narrow lines on a sheet of paper, and closing my left eye, I observed that the image was double, the false one being raised, and to the left of the true the interval filled up with a pale reddish-brown spectrum, most intense near the true image; the breadth of the interval about 0·03 inch. With my right eye closed, the image was, as I expected, to the right and above, (in both instances towards the brow and nose,) and the interval similarly tinged, but fainter, and 0·025 inch wide.

I then took a slip of card, and made with a pen-knife a fine slit in it, and looked through it held horizontally at the square; the upper false image was no longer visible, the upper and lower sides of the square clearly defined, but the lateral sides were unchanged; on holding the slit vertically, the lateral false images disappeared and the upper and lower returned. Similar appearances occurred with the other eye.

I now took a card and made two fine pin-holes exactly in the positions of the centres of my pupils, and I found that I saw the true image as correctly as I had ever done in my life; in fact, it supplied the place of a pair of spectacles; the square, of course, being seen under a greater angle, appearing magnified. By making the pin-hole larger or smaller, the focal distance, if I may use the expression, increased or diminished proportionably. I beg further to remark, that in the sunshine I can read small print at the natural focal distance; it is only in fainter light that the double image and confusion of letters occur. Now a flattening of the cornea won't explain all this: it seems to have a more intimate connexion with some want of contractility engendered in old age in the iris. I am curious to obtain an explanation, and send this notice to you for the purpose of eliciting one.

P. S. I have since observed that wire-gauze, the wire being very fine, and the meshes about $\frac{1}{50}$th of an inch in diameter, when worn close to the eye, enables me to read small print with tolerable facility at a distance of five or six inches; when the meshes are closer, I can see the most minute objects with remarkable distinctness.

Brompton, May 4, 1850.

On the Application of Electro-Magnetism as a Motive Power. By Mr. Robert Hunt.*

A voltaic current produced by the chemical disturbance of the elements of any battery, no matter what its form may be, is capable of producing by induction a magnetic force, *this magnetic force being always in an exact ratio to the amount of matter* (*zinc, iron, or otherwise*) *consumed in the battery.*

Several forms of the voltaic battery were explained, particularly those of Daniell, Grove, Bunsen, and Reinsch, the latter being constructed without metals, depending entirely on the action between two dissimilar fluids, slowly combining.

* From the London Artizan, for July, 1850.

The author had, however, proved, by an extensive series of experiments, that the greatest amount of magnetic power is produced when the chemical action is the most rapid. Hence, in all magnetic machines, it is more economical to employ a battery under an intense action, than one in which the chemical action is slow. It has been proved by Mr. Joule, and most satisfactorily confirmed by the author, that one-horse power is obtainable in an electro-magnetic engine, the most favorably constructed to prevent loss of power, at the cost of 45 pounds of zinc, in a Grove's battery, in 24 hours; while 75 pounds are consumed in the same time to produce the same power in a battery of Daniell's construction. The cause of this was referred to the necessity of producing a high degree of excitement, to overcome the resistance which the molecular forces offer to the electrical perturbations, on which the magnetic force depends.

It was contended, that although we have not perhaps arrived at the best form of voltaic battery, yet that we have learnt sufficient of the law of electro-magnetic forces to declare that, under any conditions, the amount of magnetic power would depend on the change of state—consumption of an element—in the battery, and that the question resolved itself into this:—

What amount of magnetic power can be obtained from an equivalent of any material consumed?

The following were regarded as the most satisfactory results yet obtained:—

1. The force of voltaic current being equal to 678, the number of grains of zinc destroyed per hour was 151, which raised 9000 pounds one foot high in that time.

2. The force of current being, relatively, 1300, the zinc destroyed in an hour was 291 grains, which raised 10,030 pounds through the space of one foot.

3. The force being 1000, the zinc consumed was 223 grains; the weight lifted one foot 12,672 pounds.

The estimations made by Messrs. Scoresby and Joule, and the results obtained by Œrsted, and more recently by Mr. Hunt, very nearly agree; and it was stated that one grain of coal consumed in the furnace of a Cornish engine lifted 143 pounds one foot high, whereas, one grain of zinc consumed in the battery lifted only 80 pounds. The cost of one hundred weight of coal is under 9 pence; the cost of one hundred weight of zinc is above 216 pence. Therefore, under the most perfect conditions, magnetic power must be nearly 25 times more expensive than steam power.

But the author proceeded to show that it was almost proved to be an impossibility ever to reach even this condition, owing, in the first place, to the rate with which the force diminishes through space. As the mean of a great many experiments on a large variety of magnets, of different forms and modes of construction, the following result was given:—

Magnet and armature in contact, lifting force,			220·0	pounds.
"	distant $\frac{1}{250}$	of an inch,	90·6	"
"	" $\frac{1}{125}$	"	50·7	"
"	" $\frac{1}{63}$	"	50·1	"
"	" $\frac{1}{50}$	"	40·5	"

Thus at one-fiftieth of an inch distance four-fifths of the power are lost.

This great reduction of power takes place when the magnets are stationary. The author then proceeded to show that the moment they were set in motion, a great reduction of the original power immediately took place; that, any disturbance produced near the poles of a magnet diminished, during the continuance of the motion, its attractive force.

The attractive force of a magnet being 150 pounds when free of disturbance, fell to one-half, by occasioning an armature to revolve near its poles.

Therefore, when a system of magnets which had been constructed to produce a given power is set in revolution, every magnet at once suffers an immense loss of power, and consequently their combined action falls, in practice, very far short of their estimated power. This fact has not been before distinctly stated, although the author is informed that Jacobi observed it.

And not merely does each magnet thus sustain an actual loss of power, but the power thus lost is converted into a new form of force, or rather becomes a current of electricity, acting in opposition to the primary current by which the magnetism is induced.

From an examination of all these results, Mr. Hunt is disposed to regard electro-magnetic power as impracticable, on account of its cost, which must necessarily be, he conceives, under the best conditions, 50 times more expensive than steam power.

The Chairman agreed with Mr. Hunt in his conclusion of the improbability of any result being obtained from electro-magnetism which could enable it to compete with steam as a motive power. At any rate, the point to which the attention of engineers and experimentalists should be turned at the present was, not the contriving of perfect machines for applying electro-magnetic power, but the discovery of the most effectual means of disengaging the power itself from the conditions in which it existed stored up in nature. Mr. Faraday assured us that in a single drop of water is contained as much electricity as is developed in a thunder storm. The portion of this which we can liberate by any existing battery is very small; so small that, as shown by Mr. Hunt's paper, its practical use cannot be profitable. The study of electro-chemistry, he thought, was a more promising field, and one from which might, at a future time, be developed a power which should supersede even steam.—*Proc. Soc. Arts, May* 22, 1850.

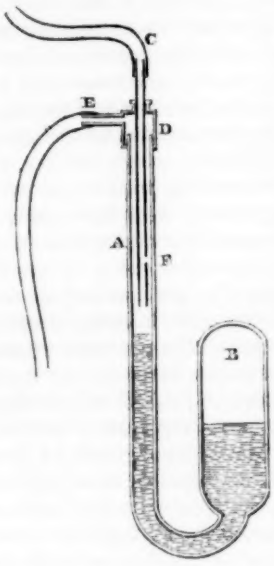
Description of an Apparatus for Regulating the Heat Produced by a Gas-Burner. By Alexander Kemp.*

Any one who has had occasion to maintain an object at a regulated temperature for a length of time by means of a gas-burner, must have experienced the difficulty of keeping the heat at the required point from two causes. First, the quantity of gas passing through the burner in any given time varies directly as the pressure on the service-pipes; a greater quantity is therefore consumed when the pressure increases, and the amount of heat applied to the object is increased in the same degree.

* From the London, Edinburgh, and Dublin Philosophical Magazine, vol. xxxvi.

Secondly, as the temperature of the atmosphere is liable to change during the continuance of the experiments, its cooling influence will be greater at one time than another. Both these causes conduce to render the attainment of the object in view one of considerable difficulty.

It will be evident, from what I have just stated, that any instrument intended to supply the desideratum must be self-acting, and must supply the gas to be consumed exactly as it is required. The instrument I have been in the habit of using for some time back consists of an air-thermometer. AB, containing mercury in the lower part of bulb B and part of the stem A. A tube of smaller diameter, marked C, passes down the axis of the tube A, the annular space being made air-tight by a small brass stuffing-box, D, by means of which it may be retained at any required elevation. In using the instrument, the bulb B is placed in the same situation as the body to be exposed to the heat of the gas-flame; for instance, if it is a water-bath containing vessels or other objects, it is immersed in the water; or if an air-chamber or hot-press, it is placed as near the object as possible, so that the air in the bulb may attain the same temperature as the surrounding medium.



A tube of vulcanized Indian rubber is now to be connected with a stop-cock attached to the service-pipe, and its other extremity drawn over the end of the pipe C, which will make it sufficiently air-tight. A second India rubber tube is in like manner to be attached at E, to convey the gas to the burner employed as a source of heat in the operation.

Let us now suppose that it is required to keep an object at a temperature of 100° F., the bulb of the instrument being placed contiguous to the object; the stop-cock is to be opened so as to allow a free supply of gas to the burner, which is now to be kindled; the heat now begins to act on the air contained in the ball of the instrument, causing it to expand and force the mercury up the stem A; when it is found, by the use of a common thermometer, that the heat has risen to 100°, the tube C is to be pushed down till its lower extremity is immersed in the mercury. This would, of course, cause the flame to be extinguished; but, to prevent this occurring, a small hole is bored through the inner tube opposite F, which permits a small quantity of gas to pass to the burner. As the passage of the gas is now interrupted, the source of heat is withdrawn, and the cooling influence of the surrounding air comes into play, which will cause the air contained in B to contract and the mercury to sink in A, leaving the end of C uncovered, and thus open a free passage to the gas, which by its combustion would again raise the temperature

so as to cut off the supply; but in a very short time these two opposing forces come to an equilibrium, and the flame scarcely varies in size.

After trying the instrument in the form described, I experienced a practical difficulty from the want of perfect contact between the end of the tube C and the mercury, from which I found that it might rise many degrees beyond the assigned limit without sufficiently lowering the flame; this I at once saw might be overcome by making the tube of a substance which would become *wetted* by the mercury. I tried a brass and also a copper tube, amalgamated at the end, but they slowly dissolved in the mercury, which they rendered impure, so that its rise and fall could not be depended on with the required nicety. The substance now used is platinum, of which about half an inch of the lower end of the tube is formed, amalgamated by dipping it into a liquid amalgam of sodium and mercury. In connexion with this I may mention, that platinum, iron, and steel, may be readily amalgamated in the same way, or by using a strong solution of caustic potash or soda in contact with the mercury.

I have now used several of these instruments for various periods, and have found them to answer well. In one operation, conducted in Professor Gregory's laboratory (the fermentation of sugar into butyric acid), one of them has been in use for upwards of six weeks, keeping about five gallons of liquid at a temperature of 98° F., and it has not been observed to vary. I have also another in an apparatus for artificial incubation, where the temperature in the well part is kept at 120° F. For this latter purpose I consider it well adapted, as it may be placed in the vessel along with the eggs, and thus the use of hot water be altogether dispensed with, as well as the constant attendance required to regulate the heat applied to the eggs.

I need not take up space with pointing out many applications that may be made of the instrument; these will occur to every one: but there is one I may allude to, viz., obtaining products of the decomposition of organic bodies at fixed temperatures, which has hitherto been somewhat difficult, as different substances are formed as the temperature varies to which they are subjected. The only limit to its application is the same as in the ordinary thermometer, viz., the boiling of the mercury; this might be overcome by using an easily fusible metal, such as tin, and constructing the instrument of iron, when its form might also be modified to suit particular circumstances.—*From the Chemical Gazette for May* 15, 1850.

Improvements in the Manufacture of Steel, Patented by Josiah Marshall Heath, *of Hanwell, Middlesex county, England, September* 6, 1849.*

My invention consists in the application of iron, produced from iron ores without being brought to the state of pig or cast-iron, to the manufacture of steel, the iron so produced being manufactured by a peculiar process discovered by me, which renders it more suitable for conversion into steel, than any iron hitherto made by the processes actually in use.

I have found that the excellence of steel depends upon the compara-

* From the London Repertory of Patent Inventions, May 1850.

tive purity or freedom from mixture with extraneous substances of the iron from which it is made.

All iron made by smelting the ores of that metal in a blast furnace contains impurities, in consequence of the alloys formed between the fluid metal and the earthy alkaline or other extraneous substances contained in the ores, the fuel, and the matters used to flux the ores.

These impurities can never be completely removed from the metal by the operations in use for converting the pig into malleable iron.

All the iron used for conversion into steel in this country is made from pig-iron, and, consequently, contains more or less impurity. The nearest approach that can be made to the production of absolutely pure iron, is by deoxidating pure iron ores by the well known process of cementation with carbon; I have found, however, that the metallic product so obtained upon a manufacturing scale, is totally unfit for the production of good steel, without further preparation; but that when subjected to the treatment hereinafter described, the result is an iron fit for making steel of finer quality than that now made from the best foreign iron. Any pure ore or oxide of iron from which the earthy or other extraneous matters can be easily separated by the mechanical operations of crushing, winnowing, washing, or magnetic attraction, may be treated in the manner I propose, but I prefer the magnetic ore of iron to all others. The ore is to be reduced to the state of grains, or even of fine powder, in order to facilitate the separation from it of the earthy or other extraneous substances, the pure ore is then to be reduced to the metallic state by any of the well known processes for depriving the metal of oxygen by acting upon it with carbon or any other reducing agent at a heat below that required to bring the metal to the fluid state. The metallic product obtained in this way, when operating upon a manufacturing scale, can never be obtained absolutely free from the last portions of earthy or other impurity, and always contains some portion of oxide of iron, which renders it quite unfit for conversion into steel of good quality, as it comes from the process of deoxidation without further treatment.

To make a perfect steel iron, I take the metallic product as it comes from the process of cementation or deoxidation, and mix it with a small portion of oxide or chloride of manganese, and a certain portion of coal or fir tar, or any cheap hydrocarbon or carbonaceous matter. I do not confine my invention to the use of any fixed proportions of these substances, for the proportions to be employed in each case will vary with the varying conditions of the mass, as the more or less perfect of the oxide, and the quantity of resident carbon mixed with it, but I have obtained the best results from the mixture of from one to three pounds of oxide or chloride of manganese, and from one to two gallons of coal or other tar to each one hundred pounds of deoxidated ore.

This mixture of granular iron, tar and manganese, resulting from this process, is heated in a suitable furnace, and when the iron is at a welding heat, it is removed from the furnace, and subjected to the action of some suitable instrument of compression, in order to be formed into a solid bloom by any of the usual processes now in use.

The bloom is then to be reheated and shingled, hammered, or rolled into bars in the usual manner. The bar-iron so produced is to be con-

verted into steel by the well known processes now in use, and its quality will be found superior to that made from the best iron hitherto procurable.

I do not claim as my invention any process or apparatus for reducing iron ores to the metallic state by cementation or deoxidation.

But what I do claim as my invention is,

The treatment of the metallic product obtained from iron ores by deoxidation in the manner above described, and the application of the iron so produced to the manufacture of steel by whatever means the conversion of the said iron into steel may be effected.

On Alloys of Copper and Tin, and the Manner in which they behave when heated. *By* M. C. J. B. KARSTEN.*

In the experiments undertaken by M. Karsten, alloys were formed by melting together 100 parts of tin, and 50, 100, and 200 parts of copper respectively. These alloys remained perfectly homogeneous, not only in the fluid state, but also after cooling, either slowly or very quickly, the three compounds were brittle and white. Their perfect homogeneity left no doubt of their being chemical compounds of copper and tin, and, consequently, compounds having definite proportions, even after cooling. These compounds did not undergo any change on being afterwards submitted to heat.

On increasing the per centage of copper, so as to combine 100 parts of tin with 400 of copper, the alloy obtained presented, on being allowed to cool very slowly in the crucible, a reticulated sieve-like appearance, and a close grain: it had a dirty white color, and was somewhat brittle. When this alloy was poured quickly into a cold iron ingot-mould, it retained its properties; no change, therefore, appeared to take place, either by slow or rapid cooling. But when it is raised to a red heat, and run into moulds, the retention of the properties which it possessed before the application of heat, or, on the other hand, the formation of an alloy, of a yellowish-white color, ductile and of granular texture, will depend upon the mode of cooling adopted. This latter quality is produced when the hot compound is suddenly cooled by plunging it into water; while the primitive compound is produced by slowly cooling in the air. If, on heating, the temperature be raised a little too high, small silver-white globules will exude from the still solid mass; but these will disappear on continuing the heating until the whole mass becomes liquid. These phenomena, produced by the application of heat, and also the non-homogeneous quality of the alloy, which has been suddenly cooled down from a red heat, evidently show that, at a temperature not sufficiently high to produce fusion, the mixture undergoes another change as to proportions; as it forms a combination of a more fluid nature than a compound containing more tin and less copper, which compound is destroyed by slow cooling, but which still exists on cooling quickly in water, as the alloy solidifies too quickly to allow the primitive general combination of the two metals again to take place. These modifications

* From the Lond. Journ. Arts, Sciences, and Manufactures, October, 1850.

do not present themselves in all alloys wherein copper greatly predominates, because their great fluidity renders a change in their properties impossible.

On the same principle, in any alloy consisting of 100 parts of tin and 400 of copper, the primitive general combination of the two metals is completely re-formed by cooling slowly from a red heat. These changes in the proportions, owing to a difference in the degree of temperature and the method of cooling the heated mass, perfectly explain why this alloy behaves, as regards ductility under the hammer, at a red heat, exactly in the same manner as after sudden cooling; and also why this slowly-cooled alloy, and that which was not carried to a red heat, are both brittle, and will not work under the hammer.

On increasing still further the per centage of copper, by combining, for instance, 100 parts of tin with 1100 parts of copper (which proportions are usually employed for gun metal,) properties of a totally different nature are presented. By very slowly cooling the alloy in a state of fusion, it appears to the naked eye perfectly homogeneous; but on applying a lens, the faces of a recent fracture will lose this appearance, and a white metallic alloy will be seen to have been detached in the midst of the reticulated faces of another alloy, of a reddish-yellow color. On being wrought and polished, the surface, however, appears homogeneous, as the tenacious reddish-yellow alloy prevents the white friable compound, which is dispersed in small grains throughout the mass, from being apparent.

On causing a sudden cooling or solidification of the fluid alloy, in the form of small ingots, by pouring it into an iron ingot-mould as thick as possible, and in a cold state, a homogeneous combination is formed, the fracture of which does not present any heterogeneity; the alloy therefore remains as homogeneous as in the fluid state. If the ingot be heated to an intense and continuous red heat, and in that state be plunged into water, it retains its homogeneous character; whilst, if cooled very slowly in the air, it acquires the property of the liquid alloy slowly cooled in the air: that is to say, a granular white compound is produced, which is deposited in the midst of a reddish-yellow reticulated mass. This compound, cooled slowly, behaves in exactly the same manner at a sustained red heat. If plunged into water at a red heat, it is homogeneous—if slowly solidified, it preserves its heterogeneity.

An alloy composed of 100 parts of tin and 1100 parts of copper can only be homogeneous at an elevated temperature; that is to say, at the temperature of fusion, or at an intense red heat.

If the temperature be lowered; at least two combinations are formed—the compound which is thus solidified, being a mixture of two compounds, having definite chemical proportions:—their formation may be prevented by sudden cooling. This metallic mixture, on being heated, behaves in a very different manner from d'Arcet's alloy; and this difference is a consequence of the change in the proportion of the tin to the copper; which proportion in d'Arcet's compound, is sufficiently considerable to cause the former metal to remain united with the copper at any temperature; but, at a red heat, gives rise to two combinations, which destroy each other, both at the temperature of fusion and at the

ordinary temperature. The alloy, constituting gun-metal, contains so little tin, that the two metals require to be at the temperature of fusion, or at a very elevated temperature, to remain in combination; on lowering the temperature, they will separate, and this can only be prevented by sudden cooling. Cannons, cast in gun-metal, do not, therefore, any more than cast-iron guns, consist of two metals, in chemical combination, but of a mixture of at least two compounds of copper and tin, mechanically set, as it were, into each other. An alloy, consisting of 100 parts of tin and 1100 parts of copper, could not therefore be a homogeneous compound, unless it were possible to cool and solidify the fluid mixture momentarily, or to expose the castings, after having been slowly cooled, to a red heat, and then cool them suddenly in water. But these two methods are impracticable, by reason of the great bulk of the castings: the only practicable method being, to allow the pieces to cool slowly in the mould. If the substance of which the mould is formed is an excellent conductor of heat, then the compound, which has lost much of its fluidity, is quickly brought to the solid state, and an instructive phenomenon takes place; which is, that after the metal has coagulated in the mould, the compound possessing the greatest degree of fluidity rises, and boils in the "gate." Instead of contracting, on solidification, this compound appears rather to expand, as it is seen to rise in the mould. On examining the condition of a piece of cannon, thus cooled, it will be found that the surface of the fractures is full of holes and bubbles, and that the piece is not fit for service. M. Karsten states that he found a dilated alloy of this kind, which was of a white color, and very brittle, composed of 21 parts of tin and 79 of copper.

If the moulding sand be surrounded, as is now done in the new processes of casting, with cast-iron moulds, these latter acquire a very high temperature after running the metal; and as soon as the above-mentioned phenomenon of the rising of the most fluid portion of the alloy takes place. But if the old method of moulding in clay be adopted, or if a substance be employed in the mould of as low a conducting power, and as dense and little porous as poseible, the iron mould will not become heated, and the metal will shrink and coagulate without this phenomenon taking place; the alloy will remain fluid during a much greater length of time, so that the least fusible compound will not solidify at the moment of moulding, but will remain in combination with the more fluid and still hot portion; from which results a more regular deposit of the alloys one upon the other. These two alloys may be very distinctly seen with the naked eye, on examining a recent fracture.

The chemical composition of the least fluid combination cannot be easily determined, as it is impossible to separate the red and tenacious compound from the white and brittle one with which it is intermixed. The latter compound may, however, be obtained in a state of purity, as by reason of its greater fluidity it is separated in the mould when the less fluid portion solidifies, so as to be free from all mechanical mixture. It is white, hard, and brittle, and has received the name, from German casters, of *krätz métal*, (waste metal:) M. Karsten found its composition to be 17·7 parts of tin and 82·3 parts of copper.

A variety of easily fusible compounds of tin and copper, possessing

definite proportions, are therefore capable of formation, in which the per centage of copper augments proportionably to the speed at which the cooling is effected. Under these circumstances it may be well to explain the fact, which the experiments of artillery officers have proved, viz: that pieces of large calibre are not so durable as those of less calibre, although the composition of the alloy, and the operation of moulding them, may have been the same. The bore of pieces of large calibre is of softer metal, and consequently increases in diameter more rapidly by use than those of smaller calibre; because the large pieces necessarily take a much longer time in cooling, and the more fluid part of the mass, formed in this slow cooling, contains less tin, and is consequently softer than the alloy, which is as fluid, but is more rapidly cooled. These phenomena also lead to the following result, viz: that not only are the combinations of the alloys determined, in many cases, by differences of temperature; but also the compounds, already formed, may undergo a change, by merely raising the temperature, without its being requisite to bring the compounds to a fluid state, and without any disengagement of gaseous matter.—[*Technologiste.*]

Description of Improvements in Producing Ornamental Designs on Papier-Maché, and in Preserving Vegetable Matters. Patented by WILLIAM BRINDLEY, *Twickenham, England, May*, 1850.*

The first part of this invention consists in an improved mode of producing ornamental designs on papier-maché.

The patentee takes the sheets of wet paper, as they come from the sieve, and places them one upon another until he has obtained the desired thickness; then before pressing them, he places the accumulated mass of sheets upon the oiled pattern, and lays a sheet of water-proof paper (oiled paper) on the top thereof, and on it several more sheets of wet paper; after which he subjects the whole to pressure; and then he clamps the whole together and stoves the same. The object of applying the wet paper to the pattern (before being pressed) is in order that such materials as leaves and flowers of plants and trees may be used as the pattern surface or part of the pattern surface: which materials, being very delicate, would not admit of the "green" paper being used after being pressed. In preparing the pattern surface, the patentee prefers to employ panel board, on which he places the leaves or flowers of plants or trees (such matters being well oiled,) and then on them he lays the sheets of wet paper.

The second part of the invention consists in an improved method of preserving vegetable matters, such as the leaves, stalks, and flowers of plants, by oiling them, and then placing the same between sheets of paper and stoving them in the same manner as articles made of papier-maché: the patentee employs a temperature of from 250° to 300° Fahr.

The patentee claims as his invention, Firstly,—the producing ornamental surfaces on papier-maché, by employing unpressed wet paper;

*From the London Journal of Arts and Sciences, May, 1850.

and also the employment of the leaves of plants or flowers, or parts thereof, in making ornamental surfaces in papier-maché. Secondly,—the preserving of vegetable matters, such as the leaves, stalks, and flowers of plants.

Translated for the Journal of the Franklin Institute.

Experiments on the Tenacity of the Principal Malleable Metals, made at Temperatures 0°, 100° and 200° Cent. (32, 212° and 392° Fahr.) by M. Baudrimont.

In 1843, I undertook the experiments on the tenacity of metals, at the temperatures 0°, 100°, and 200° (cent.) which are the subject of the present memoir.

The metals submitted to experiment were copper, gold, platina, silver, palladium, and iron, wire.

These wires were stretched horizontally in baths of melting ice, boiling water, and oil heated to 200° cent. (392° Fahr.)

The traction was exercised by dry sand, which flowed slowly into a vessel which received it. The flow could be stopped at pleasure. As soon as the wire broke, the vessel falling, started a spring, which instantly stopped the flowing of the sand.

The vessel, the sand which it contained, and the hook which carried it were then weighed in an excellent balance.

The results thus obtained are consigned in the following table:

Tenacity of the Principal Malleable Metals, at the temperatures 0°, 100°, & 200°, (Cent.) for diameters and sections determined by experiment; and for a square millimetre of section found by calculation.

Metals.	Diameter at 16° C. (60·8° F.)	Area of the cross section.	Maxima and Means.	Tenacity.			Tenacity per sq. millim. of cross section.		
				0°	100°	200°	0°	100°	200°
	mm.	sq. mm.		kil.	kil.	kil.	kil.	kil.	kil.
Gold,	0·41250	0·13364	Max'a.	2·546	2·107	1·750	19·051	15·766	13·094
			Means.	2·459	2·035	1·722	18·400	15·224	12·878
Platina,	0·41000	0·13202	Max'a.	3·040	2·696	2·392	23·026	20·421	18·118
			Means.	2·987	2·546	2·281	22·625	19·284	17·277
Copper,	0·48000	0·18095	Max'a.	4·585	3·990	3·590	25·338	22·050	19·839
			Means.	4·542	3·958	3·296	25·100	21·873	18·215
Silver,	0·39825	0·12456	Max'a.	3·546	3·055	2·329	28·620	24·526	18·705
			Means.	3·528	2·898	2·314	28·324	23·266	18·577
Palladium,	0·39750	0·12409	Max'a.	4·590	4·083	3·625	36·983	32·871	29·212
			Means.	4·527	4·031	3·360	36·481	32·484	27·077
Iron,	0·17500	0·02105	Max'a.	5·046	4·835	5·130	209·813	201·039	213·305
			Means.	4·940	4·611	5·057	205·405	191·725	210·270

[Note.—The French millimetre is 0.0394 of an inch, and consequently the square millimetre is 0.00155 square inch. The kilogramme is 2.205 lbs. avoirdupois, and the degree of the Centigrade thermometer equal to 1·8° of Fahrenheit, the zero of the Centigrade corresponding to 32° Fahrenheit.]

From the experiments here recorded it results,

1st. That the tenacity of the metals varies with the temperature.

2d. That in general it decreases, as the temperature rises; but this is not without exceptions.

3d. That in the case of silver, it diminishes more rapidly than the temperature.

4th. That for copper, gold, platina, and palladium, it decreases more slowly than the temperature.

5th. That iron presents a very remarkable peculiarity. At 100° (212° Fahr.) its tenacity is less than at 0°; (32° Fahr.) but at 200° (392 Fahr.) it is greater than at this latter temperature.

—Comptes Rendus of the Academy of Sciences at Paris, 29 July, 1850.

Description of Improvements in Coating the Surfaces of Pumps, Pipes, Cisterns, and other articles of Iron. Patented by WILLIAM WYATT, *of the County of Worcester, England, April*, 1850.*

This invention consists in coating cast iron pumps, cast iron pipes, cast iron cisterns, and other articles of cast iron, with a glass or glaze.

The glass is composed of lead, borax, and silex, which are combined in the proportion of three parts, by weight, of white lead (or one part of red lead and two parts of white lead,) two parts of borax, and one part of calcined flint. These ingredients, being well mixed together, are to be fused in a crucible, run into water, and then ground with water in a glaze mill; and when the mixture is thoroughly reduced, so that it will readily pass through a silk or lawn sieve, such as is used by china manufacturers, it will be ready for use: it is not absolutely necessary to fuse the materials; but it is better to do so. The glaze thus prepared, being about the consistence of cream, is applied to the inner surfaces of pump barrels, pipes, and similar articles of cast iron, by closing one end, introducing a quantity of glaze, turning the article round, so as to coat the interior uniformly with the glaze, and then pouring out the surplus. The interior of cisterns and like articles of cast iron is coated in a similar manner, by introducing a quantity of glaze and moving the article about in various directions until the interior is uniformly coated. In general it will only be necessary to scour and wash the surface, previous to coating; but if the surface is much oxidized, it is requisite to subject the articles to a red heat, and, when cool, to scour them well with water. It is preferred to warm the metal before the application of the glaze, in order to facilitate the drying of the latter. The exterior surfaces of articles of cast iron may be coated by dipping the articles into the semi-fluid glaze, or by applying the glaze thereto with a brush.

After the pumps, pipes, cisterns, or other articles of cast iron have received a coating of glaze, they are to be subjected to a suitable temperature for firing the glaze, and thereby causing it to adhere. This is effected by placing the articles in a kiln heated in such manner that no flame or sulphur shall come in contact with the articles. The heat is gradually raised until the glaze melts (which can be seen by taking out a

* From the London Journal of Arts and Sciences, May, 1850.

brick from an opening in the kiln); and, so soon as the melting of the glaze takes place, the fires are drawn, and the articles are allowed to cool: when the articles have become cool, they are removed from the kiln, and are ready for use.

The patentee does not confine himself to the precise quantities of the matters above mentioned, nor to the precise details of the above described process; but what he claims as his invention is, the coating with a glaze, such as above explained, the surfaces of cast iron pumps, cast iron pipes, cast iron cisterns, and other articles made of cast iron.

Extracts from the Address of the President (Sir David Brewster) *before the first general Meeting of the British Association for the Advancement of Science, held July* 31*st*, 1850.

"The other object of the British Association, mentioned by Mr. Harcourt, the Organization of Science as a National Institution, is one of a higher order, and not limited to individual, or even to English, interests. It concerns the civilized world; not confined to time, it concerns eternity. While the tongue of the Almighty, as Kepler expresses it, is speaking to us in His Word, His finger is writing to us in His works; and to acquire a knowledge of these works is an essential portion of the great duty of man. Truth secular cannot be separated from truth divine; and if a priesthood has in all ages been organized to track and exemplify the one, and to maintain, in ages of darkness and corruption, the vestal fire upon the sacred altar, shall not an intellectual priesthood be organized to develope the glorious truths which time and space embosom—to cast the glance of reason into the dark interior of our globe, teeming with what was once life—to make the dull eye of man sensitive to the planet which twinkles from afar, as well as to the luminary which shines above—and to incorporate with our inner life those wonders of the external world which appeal with equal power to the affections and to the reason of immortal natures. If the God of Love is most appropriately worshipped in the Christian temple, the God of Nature may be equally honored in the Temple of Science. Even from its lofty minarets the philosopher may summon the faithful to prayer; and the priest and the sage may exchange altars without the compromise of faith or of knowledge. Influenced, no doubt, by views like these, Mr. Harcourt has cited the opinions of a philosopher whose memory is dear to Scotland, and whose judgment on any great question will be everywhere received with respect and attention; I refer to Prof. Playfair, the distinguished successor in our Metropolitan University of the Gregorys, the Maclaurins, and the Stewarts of former days, who in his able dissertation "On the Progress of the Mathematical and Physical Sciences" thus speaks of the National Institute of France:

"This institution has been of considerable advantage to science. To detach a number of ingenious men from every thing but scientific pursuits—to deliver them alike from the embarrassments of poverty and the temptations of wealth—to give them a place and station in society the most respectable and independent, is to remove every impediment, and

to add every stimulus to exertion. To this institution, accordingly, operating upon a people of great genius and indefatigable activity of mind, we are to ascribe that superiority in the mathematical sciences which, in the last seventy years, has been so conspicuous."—*Diss. 3d, sec. 5, p.* 500.

This just eulogy on the National Institute of France, in reference to abstract mathematics, may be safely extended to every branch of theoretical and practical science; and I have no hesitation in saying, after having recently seen the Academy of Sciences at its weekly labors, that it is the noblest and most effective institution that ever was organized for the promotion of Science. Owing to the prevalence of scientific knowledge among all classes of the French population, and to their admirable system of elementary instruction, the advancement of science, the diffusion of knowledge, and the extension of education are objects dear to every class of the people. The soldier as well as the citizen—the Socialist—the Republican and the Royalist—all look up to the National Institute as a mighty obelisk erected to science, to be respected and loved and defended by all. We have seen it standing unshaken and active amid all the revolutions and convulsions which have so long agitated that noble but distracted country—a common centre of affection, to which antagonist opinions and rival interests and dissevered hearts have peacefully converged. It thus becomes an institution of order, calculated to send back to its contending friends a message of union and peace, and to replace in stable equilibrium the tottering institutions of the State. It was doubtless with views like these that the great Colbert established the Academy of Sciences in Paris, and that the powerful and sagacious monarchs on the Continent of Europe have imitated his example. They have established in their respective capitals similar institutions—they have sustained them with liberal endowments—they have conferred rank and honors on their more eminent members, and there are now here present distinguished foreigners who have well earned the rewards and distinctions they have received. It is, therefore, gentlemen, no extravagant opinion that institutions which have thus thriven in other countries should thrive in ours—that insulated societies, which elsewhere flourish in combination, should, when combined, flourish among us—and that men ordained by the State to the undivided functions of science should do more and better work than those who snatch an hour or two from their daily toil or from their nightly rest. In a great nation like ours, where the higher interests and objects of the State are necessarily organized, it is a singular anomaly that the intellectual interests of the country should, in a great measure, be left to voluntary support and individual zeal—an anomaly that could have arisen only from the supineness of ever-changing administrations, and from the intelligence and liberality of a commercial people—an anomaly, too, that could have been continued only by the excellence of the institutions they have established."

"Our English friends are, we believe, little aware of the obstructions which oppose the progress of science in Scotland. In our five universities there is not a single Fellowship to stimulate the genius and rouse the ambition of the student. The church, the law and the medical profession hold out no rewards to the cultivators of mathematical and

physical science; and were a youthful Newton or Laplace to issue from any of our universities, his best friends would advise him to renounce the divine gift, and to seek in professional toil the well-earned competency which can alone secure him a just position in the social scale and an enviable felicity in the domestic circle. Did this truth require any evidence in its support, we find it in the notorious fact that our colleges cannot furnish professors to fill their own important offices; and the time is not distant when all our chairs in Mathematics, Natural Philosophy, and even Natural History, will be occupied by professors educated in the English universities. But were a Royal Academy or Institute, like that of France, established on the basis of our existing institutions, and a class of resident members enabled to devote themselves wholly to science, the youth of Scotland would instantly start for the prize, and would speedily achieve their full share in the liberality of the State. Our universities would then breathe a more vital air. Our science would put forth new energies, and our literature might rise to the high level at which it stands in our sister land. But it is to the nation that the greatest advantages would accrue. With gigantic manufacturing establishments, depending for their perfectiou and success on mechanics and chemistry —with a royal and commercial marine almost covering the ocean—with steamships on every sea—with a system of agriculture leaning upon science as its mainstay—with a net-work of railways demanding for their improvement, and for the safety of the traveler, and for the remuneration of their public-spirited projectors, the highest efforts of mechanical skill,—the time has now arrived for summoning to the service of the State all the theoretical and practical wisdom of the country—for rousing what is dormant, combining what is insulated, and uniting in one great institution the living talent which is in active but undirected and unsupported exercise around us.—*Proceedings of the British Association, July 31st*, 1850.

On the Laws of the Elasticity of Solids. By W. J. Macquorn Rankine.*

The object of this paper is to investigate the relations which must exist between the elasticities of different kinds possessed by a given solid substance, and between the different values of these elasticities in different directions. The different kinds of elasticity possessed by a solid substance are distinguished into three: first, *longitudinal elasticity*, representing the forces called into play in a given direction by condensation or dilatation of the particles of the body in the same direction;—secondly, *lateral elasticity*, representing the force called into play in a given direction by condensation or dilatation of the particles of the body in a direction at right angles to that of the force;—and thirdly, *transverse elasticity* or *rigidity*, being the force by which solid substances resist distortion or change of figure, and the property which distinguishes them from fluids. The author's researches refer chiefly to substances whose elasticity varies in different directions. His first endeavor is to determine the laws of elasticity of such substances, as far as they are in-

* From the London Athenæum of August 10, 1850.

dependent of hypotheses respecting the constitution of matter,—a method which has not hitherto been followed. The first proposition respecting such substances is the following:—*Theorem* 1. In an elastic substance which is homogeneous and symmetrical with respect to molecular action, there are three directions at right angles to each other, in which a longitudinal strain (viz., dilatation or condensation) produces a pressure in its own direction. These three directions are called axes of elasticity. They are the proper directions for the reduction of all molecular displacements and pressures. Their existence has been demonstrated according to various hypotheses as to the constitution of matter; but the truth of the demonstrations is independent of the particular hypotheses. The elasticity of a body, referred to these three axes, is expressed by twelve coefficients—three of longitudinal and six of lateral elasticity, and three of rigidity, which are connected by the following laws:—*Theorem* 2. The coefficient of rigidity is the same for all directions of distortion in a given plane:—*Theorem* 3. In each of the co-ordinate planes of elasticity, the coefficient of rigidity is equal to one-fourth part of the sum of the two coefficients of longitudinal elasticity, diminished by one-fourth part of the sum of the two coefficients of lateral elasticity in the same plane. The investigation having now been carried as far as is possible without the aid of hypotheses, the author determines, in the first place, the consequences of the supposition of Boscovich, that elasticity arises entirely from the mutual action of atomic centres of force. The author denominates bodies so constituted *perfect solids*, and respecting them proves the following propositions:—*Theorem* 4. In each of the co-ordinate planes of elasticity of a perfect solid, the two coefficients of lateral elasticity and the coefficient of rigidity are all equal to each other:—*Theorem* 5. In each axis of elasticity of a perfect solid, the coefficient of longitudinal elasticity is equal to three times the sum of the two coefficients of rigidity for the co-ordinate planes which pass through that axis, diminished by three times the coefficient of rigidity for the plane normal to that axis. Thus, in perfect solids, all the coefficients of elasticity are functions of *three* independent coefficients—those of rigidity. In no previous investigation has the number of independent coefficients been reduced below six. To represent the phenomena of *imperfect* solids, there is introduced the *hypothesis of molecular vortices*, in addition to that of atomic centres; that is to say, each atomic centre is supposed to be surrounded by a fluid atmosphere, retained round the centre by attraction, and diffused from it by the centrifugal force of revolutions constituting heat. The author has already applied this hypothesis to the theory of the elasticity of gases and vapors, in a paper read to the Royal Society of Edinburgh, and published in their Transactions, vol. xx. Applied to solids, it leads to the following conclusion:—*Theorem* 6. In an imperfect solid, according to the hypothesis of molecular vortices, each of the coefficients of longitudinal and lateral elasticity is equal to the same function of the coefficients of rigidity which would be its value in a perfect solid, added to a coefficient of fluid elasticity, which is the same in all directions. Thus the number of independent coefficients is increased to four. The rest of the paper is occupied by the deduction of some important consequences from these

principles. This paper is intended to form the foundation of the theoretical part of a series of researches on the strength of materials.

Sir D. Brewster begged to suggest to Mr. Rankine that by an examination of the action of transparent solids on polarized light, the correctness of these theoretic views might be tested or corrected: and so accurate and simple was this method found to be of testing the nature of the constraint under which the several elements of a strained body were, that models of pieces of carpentry were now actually constructed in glass, subjected to the kind of strain to which their representatives would be exposed; and the kind and degree at each part rigorously ascertained by polarized light.—*Ibid.*

On a New and Ready Process for the Quantitative Determination of Iron. *By* Dr. F. Penny.*

The author recommends the employment of the chromate and bichromate of potash for the estimation of iron in the common ores of the metal, and especially for the analysis of the clay-band and black-band ironstone of this country. He was led to the application of these salts in the course of some recent investigations on the materials and products of the manufacture of alum from "alum-shale," in which he was much retarded by the want of a ready method for estimating the oxides of iron. The chromates of potash give very exact results, and possess the great advantage that a much larger quantity of material may be operated on than can be conveniently treated by the usual methods. For practical purposes, he says, the bichromate is to be preferred. The process requires no other apparatus than that commonly used for centigrade testing, which is familiar to all persons engaged in chemical pursuits. It may be easily and rapidly executed, occupying only a fraction of the time required for the process of estimating iron by precipitation as the sesquioxide; and it is not interfered with by the presence of alum and phosphates which usually exist in the ore. The method is based on the well known reciprocal action of chromic acid and protoxide of iron, whereby a transference of oxygen takes place, the protoxide of iron becoming converted into sesquioxide, and the chromic acid into sesquioxide of chromium.—*Ibid.*

On the Self-Imposed Taxation of the Working Classes of the United Kingdom. *By* Mr. G. R. Porter.†

The object of the author is to exhibit the amount expended on three articles of luxury, the use of which he presumes might advantageously be dispensed with, viz. spirits, beer, and tobacco; the respective values of which are £24,091,458; £25,383,165; and £7,588,607, making a total of £57,063,230.

* From the London Athenæum August 10, 1850.
† From the London Artizan, October 1, 1850.

Improvements in Certain Materials to be used in Dyeing and Printing. Patented by JOHN MERCER *and* WILLIAM BLYTH, *of Lancaster county, England, October* 12, 1849.*

The nature of our said invention consists in making double salts in a solid or concrete state, composed of oxide of tin or stannic acid, and phosphoric acid, arsenic acid, or arsenious acid, and soda, which are or may be called phospho-stannate of soda, arseno-stannate of soda, &c. These concrete or dry or solid double salts we dissolve in water, and use instead of, and for all purposes for which stannate of soda is used, in dyeing and printing cottons, de laines, and other fabrics. All the double salts of phosphoric, arsenic, or arsenious acids, with stannic acid and potash, soda, or ammonia, will answer; but we prefer the arsenic stannate of soda. We make it simply by adding to stannate of soda arseniate of soda (made by fluxing or heating equal weights of white arsenic and nitrate of soda together) in such proportions as form the strongest solid or concrete salt; this is about equal equivalents of arsenic acid and stannic acid. We take one gallon of stannate of soda liquor at about fifty twaddel, and dissolve in it (in an iron vessel on the fire) one and a half pound of arseniate of soda, made as before stated; a little of the thin mixture, while hot on the fire, is taken out and dropped on a cold plate or stone. If it immediately concrete into a solid, the fluid may be poured out on any suitable bed or receptacle, when it becomes solid as soon as cold. This constitutes our solid or concrete arsenic stannate of soda. We do not confine ourselves to the above particular way of adding the arseniate or phosphate of soda (should phosphate be desired,) for the arseniate or phosphate may be added to the soda before the tin, or before the soda be made into stannate of soda. The arseniate of soda, phosphate of soda, or arsenious acid, may be added before, or along with, or after the oxide of tin or stannic acid is united to the soda, and in all cases the same arsenic stannate of soda is formed. We do not claim any particular mode of making the stannate of soda. Any of the well known ways will make a stannate suitable for our purpose, in making double salts, as here described.

But what we claim is,

The sole manufacture and use of the solid or concrete double salts, composed of arsenic acid, or arsenious acid, and stannic acid and soda, potash or ammonia and phosphoric acid, and stannic acid, and soda, potash, or ammonia.

On the Cleansing of Metal Castings.†

In the old process of cleansing metal castings from the coating of oxide and sand with which they are covered when taken from the mould, the work is thrown into water acidulated with sulphuric or hydrochloric acid, which acts upon the surface of the metal, and more or less com-

* From the London Repertory of Patent Inventions, May, 1850.

† From the London Journal of Arts and Sciences, September, 1850.

pletely removes the covering of foreign matter. The acid, however, leaves the surface rough and unequal, and it is generally necessary, after its action, to have recourse to mechanical means to effectually take away the oxide. Some time since, M. Sorel had remarked, that the cleansing of castings was more completely effected by the acidulated water produced in certain processes employed in the depuration of oils, and left as refuse, than by a mere mixture of acid and water; and, according to the experiments of MM. Thomas and Delisse, the oxide and sand are removed from cast surfaces with great certainty and facility, if, to the water acidulated with sulphuric acid, organic matter, such as glycerine, artificial tannin, naphthaline, creosote, or stearine, be added. The acid liquor, thus prepared, does not dissolve the coating of oxide, but causes it to become detached and scale off without sensibly attacking the surface of the metal beneath; there is no disengagement of hydrogen gas, as when common dilute acid is employed, even when the immersion of the metal in the bath is continued for a very considerable time; and the surface, after the operation, is uniform, quite clean, and smooth.

In practice, it is found that, by the employment of the mixture described, 60 per cent. of acid is saved, and not one-half as much metal lost as in the old process. The new method is also peculiarly applicable to the cleansing of works in zinc and brass. It may be remarked, in passing, that, if the mixture of water, acid, and organic matter be employed as the exciting fluid in a cell of Bunsen's galvanic battery, the consumption of the zinc will be diminished to one-eighth the ordinary quantity, without in anywise enfeebling the energy of the electric current.

The substances mentioned above as being employed, in addition to the acid liquor, in the experiments of MM. Thomas and Delisse, being somewhat difficult to procure under some circumstances, particularly by persons engaged in ordinary industrial occupations, M. Elsner entered upon a series of trials, in order to ascertain whether or not certain organic matters, of a cheaper class, and more easily procurable, could not be substituted for those already tried with so much success. With this object, both wood and coal-tar were mixed with the dilute acid. As these substances contain creosote, and other products of the destructive distillation of organic bodies, the useful effect of which had been proved by the previous experimenters, it was believed that they would advantageously replace the rarer and more expensive materials first tried. The mixture of tar and dilute acid was, in fact, found to answer perfectly well the objects of the experiment: a piece of casting, in iron, was immersed in the mixture;—the metal was completely cleansed of the coating of oxide without any disengagement of hydrogen gas; and the surface was of a clear greyish-black color, quite clean, and smooth, and totally unattacked by the acid. A similar piece of casting, immersed in the kind of acid solution ordinarily used in this process, was almost wholly dissolved in an equal time.

The practical value of this process seems to be so considerable as to render it worthy of being generally known and tested by more extended trials.—*Technologiste.*

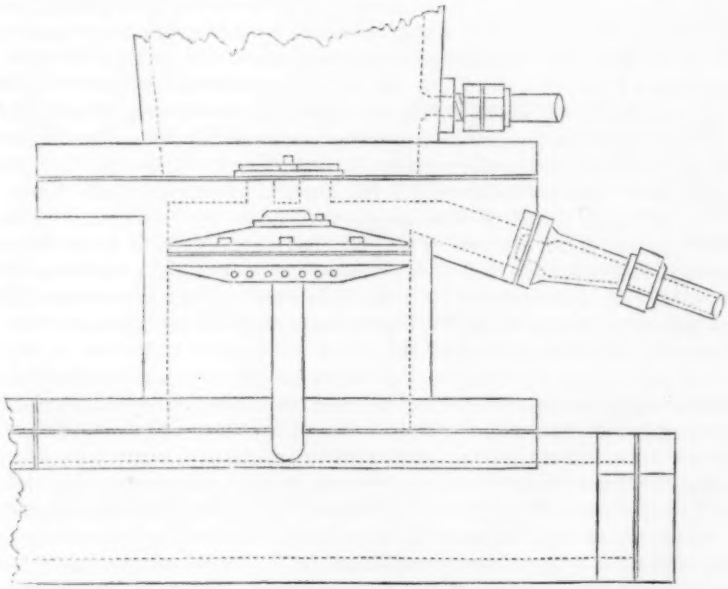
FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Report on H. P. M. Birkinbine's Hydraulic Rams.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom were referred for examination—"Improvements in the Hydraulic Ram," by Mr. H. P. M. Birkinbine, of Philadelphia, Pennsylvania,—Report:—

That the committee for a long time hoped that it would have it in its power to take advantage of this opportunity to examine into and report upon the general question of the advantages of the Hydraulic Ram, as an instrument for raising water, and to investigate the theory of this machine, with its new improvements, as had been so admirably done by Eytelwein for its old forms. The committee however regrets, that the other necessary occupations of its members, prevented them from devoting that attention to the subject, which would be necessary, in the extended and laborious series of experiments which would be required to elucidate the matter. They, therefore, reluctantly confine themselves to a simple report on the value of the improvements which Mr. Birkinbine has introduced into the instrument, and the degree of perfection, which by these improvements, and by accurate workmanship, and well studied proportion of the parts, he has given to it.



These improvements are principally as follows:—

First: constructing the discharge valve (*stop valve*, *soupape d'arret* of Eytelwein) of the ram, so that as it rises into its seat, a portion of water

is caught between the valve and seat, and thus a water-cushion formed, which prevents the heavy blow, and the consequent rapid destruction of the apparatus. The manner in which this is accomplished, is very evident, from the accompanying figure, in which it is seen that the valve is made with a small recess around its upper margin, while the seat into which it rises, has a corresponding flange, and the upper edges being so proportioned that that of the valve slides past the flange, before the valve has reached its seat, a portion of water is caught in the recess between the valve and seat, and forms the cushion.

The second improvement consists in so forming the parts, as to place the cup or air chamber, which in all these machines is placed at the discharging orifice to arrest gradually the impact of the water there, upon the valve itself, and not upon the valve seat; by this means, it is believed that the shock upon the valve is materially lessened, and the valve kept longer in use.

The third improvement consists in adjusting the drop-cup, into which the guide-stem of the valve falls, by means of a wedge, controlled by an adjusting screw, so that the amount of the fall of the valve may be accurately set, and altered when a change of circumstances require it. By means of this arrangement, the quantity of water discharged by the valve can be reduced or increased at pleasure, within considerable limits.

Another improvement consists in laying down the driving-pipe, or that which conveys the water from the fountain-head to the ram, in the form of a cycloidal curve, which, as is well known, is the curve along which a body descends from one given point to another in the shortest time, and therefore, with the greatest mean velocity. By this means the momentum of the descending column, upon which depends the effect of the ram, is increased. The credit of the calculation of this curve is due to Mr. Joseph Strode, of West Chester, an ingenious mechanic and competent mathematician, who has, as it appears, been very successful in his introduction of this ram in the vicinity of that place.

Another improvement, which the rams of Mr. Birkinbine have, in common with those of several other patterns now constructed, is an arrangement of inclined water ways, by which the valve is made to rotate slowly, while it rises and falls, thus preventing it from striking twice successively in the same place, and thus avoiding irregular wear. This is evidently an improvement of some importance, the origin of which is, however, not claimed by Mr. B.

In addition to these improvements in the ordinary ram, Mr. Birkinbine has introduced an improvement into the double-acting or piston ram, first suggested by Montgolfier, the inventor of the machine, and very useful in certain cases, since it allows the whole quantity of water from a feeble spring of soft or mineral water, to be raised by the power of a heavier stream of water, not itself fitted for the uses for which the water is wanted. The arrangement of Montgolfier consisted in elevating the air vessel of the ram upon a chamber, into which a solid piston was introduced. Into this chamber, above the piston, but below the valve leading to the air vessel, is the entrance pipe of the water to be raised. The stream of working water passes through the body of the ram below the piston, and by its inertia, when the discharge valve closes, forces up the piston, by

which the water lying upon it is driven into the air vessel. This arrangement has been, however, found of little or no use, in practice, in consequence of the accumulation of air under the piston, which then ceases to work. This is remedied in Mr. B.'s construction, by a small air valve in the piston, by which this accumulation is prevented. It is true that by this means, a very small quantity of the lower water is permitted to pass into that above the piston, but this will not take place to any hurtful extent.

This enumeration, it is believed, contains the principal modifications which characterize the rams constructed by Mr. Birkinbine. The committee would have been very glad to have studied them separately, in order to appreciate their several effects, but the causes above enumerated have obliged them to abandon this attempt, and content themselves with the examination of the instrument when complete. Mr. Birkinbine has stated to the committee, that he has up to this time constructed and put in use about 1000 of these rams, and that they have very generally been found to give entire satisfaction to their owners.

The largest of these are worked by driving pipes of 6 inches diameter. Such is the ram constructed for the town of Naples, in New York, intended to supply the town with water. The fall is 6 feet, and the water is lifted 60 feet high. It is calculated to raise, when in full action, 20,000 galls. per day. A ram of the same size is erected at Hazleton, on the Lehigh. The fall here is 8 feet, and the rise 117 feet. The delivery pipe is 2300 feet long and 1½ inches in diameter. A ram of the same size has been sent to Cuba, but not heard from.

A ram of 5 inches diameter of driving pipe is erected upon the Mine Hill and Schuylkill Haven Railroad, with a fall of 4 feet, and a rise of 40 feet, through a 2½ inch pipe.

The committee have not been able to get the data for calculating the practical coefficient of these rams, but they had that opportunity with one which was erected for the purpose of supplying the Girard College with water, which had a driving pipe of 2½ inches diameter, and 160 feet in length—the fall 14 feet. The delivery pipe was 2260 feet long, 1 inch in diameter, and the height to which the water was raised 93 feet. The coefficient determined by the committee was 71 per cent., which when we consider the great friction met with in forcing water through so long and narrow a pipe, which being of lead, could not be laid entirely straight, must be considered as fully establishing the high practical effect of these instruments.

The committee tried a number of experiments upon several rams at the shop of the maker, in which they also frequently got high results, but as these experiments were not for the purpose of determining the coefficient but for the purpose of studying the effects of various changes, such as the weight and length of fall of the valve, the length and diameter of the driving and delivery pipes, the number of strokes per minute, &c., and as they are incomplete, they do not think it worth while here to record them. In conclusion, however, they have no hesitation in expressing their opinion, that the Hydraulic Rams, constructed by Mr. Birkinbine, are very efficient instruments for raising water, and peculiarly valuable in many circumstances to our agriculturists; and that the modifications in

their arrangement, which constitute their peculiarity, are valuable improvements, inasmuch as they permit the instruments to be made of larger size, and render them more lasting, and less apt to get out of order.

By order of the Committee.

WILLIAM HAMILTON, *Actuary.*

Philadelphia, May 9, 1850.

COMMITTEE ON EXHIBITIONS.

Address Delivered by HON. WM. M. MEREDITH, *at the close of the 20th Exhibition of American Manufactures, held by the Franklin Institute, October*, 1850.

Many societies have been formed for the promotion of science and the arts, but of them all the Franklin Institute is probably the most useful because the most practical. Its activity is not confined to an annual exhibition. Its functions are always in active exercise, and its beneficial effects are felt through the whole circle of mechanic arts. Its premiums are awarded with an impartiality and judgment which are recognised by the whole community, and hence the ingenious mechanic who has obtained one of these honorable distinctions, has obtained with it a just reputation in his art and a sure hold upon a good and profitable custom. This institution has imitators and emulators elsewhere; but we are proud to believe that in none of them do the members combine to a greater extent the highest degree of science with the most practical knowledge of and experience in mechanical details.

The active organization of the Franklin Institute is threefold, and consists of the Society at large, the Board of Managers, and the Committee on Science and the Arts.

Each of these bodies has its distinct and separate duties, powers and functions, which are executed, in a great measure, independently of the others.

The operations of the Society, which are carried on by means of annual and monthly meetings, and through the agency of various committees, embrace most of the public transactions of the Institute, and the custody and arrangement of its peculiar property, such as the Hall, the Library, and the Cabinets of models and minerals; and at the meetings of the Society, are held the discussions on matters of general interest.

The Society now numbers over 2000 members. The Library contains more than 5000 volumes. The Cabinets contain some 350 models, and between 7000 and 8000 specimens of minerals.

The Board of Managers is elected by the Society at its annual meeting, and has the custody and control of the funds of the Institute, and the direction of the Schools, the Lectures, Exhibition, and the Journal.

The receipts from these sources, together with the contributions from members, constitute the revenue of the Institute.

The Committee on Science and the Arts is composed of those members of the Society who voluntarily enroll themselves as members of that Committee, and agree to perform the duties required of them. These duties embrace the investigation of scientific and mechanical problems of

general interest, and investigations of questions submitted for their decisions, by individuals or corporations, municipal or others, or by the State or Federal Government.

Since its origin this Committee has raised more than 500 sub-Committees, charged with different investigations, or with the examination of inventions, the authors of which desired either a written report or private advice.

The labors of the members of this Committee have been bestowed upon many subjects of public interest, among which have been, an elaborate investigation of the causes of the explosion of steam boilers, undertaken with the approval of the government of the United States.

An examination and report upon a system of weights and measures, made at the instance of the State of Pennsylvania.

An extensive series of experiments upon different forms of water wheels.

A report to the Councils of the City of Philadelphia on the best methods of paving the streets of the City. An examination at the instance of the same bodies, upon the best form of lamp for street lighting.

A scheme for the prevention of steam boiler explosions, by legislative enactments. And repeated experiments upon the friction of heavy masses in motion—such as vessels at launching. The two latter subjects are in charge of standing sub-committees.

There is one subject, intimately connected with the welfare of the mechanic arts, to which the attention of the parties interested cannot be too often invited; I mean, the defects in the existing Patent Laws.

These laws as they at present exist, I fear it must be acknowledged, do not "promote the progress of Science and the useful Arts," but rather impede and embarrass their progress:—they do not "secure to inventors the enjoyment for a limited time, of the exclusive use of their discoveries,"—on the contrary, they make the ultimate discovery of almost every inventor the same, viz., that whatever may be his fame in the next generation, his fate in the present is unceasing, and ruinous litigation —while the mere pretender is sometimes enabled to vex the community for a series of years by extortions, under color of supposed or frivolous inventions.

This subject should be presented and re-presented at every opportunity, with such suggestions as may occur, until some adequate remedy shall have been applied; and I think there should be in every mechanical institution, a standing Committee on the Patent Laws.

The principal ends of Patent Laws are, or ought to be,

1. To secure the granting of patents for useful inventions, and for none others.

2. To prevent the violations of patents so granted.

3. To secure to the public the use of patented inventions on reasonable terms, and to patentees a reasonable reward for their ingenuity.

1. For the present insufficient mode of examining the question of originality before the issue of a patent, I would substitute something like the following:—Public notice to be given of the application for a patent, accompanied by a copy of the specification filed, and calling on all persons who may object to the application, to present to the Commissioner

of patents in writing the grounds of their objection within a limited period, say 12 months. At the expiration of that period, the examination should take place, by a board of competent examiners. If necessary, they should have authority to cause depositions to be taken with notice to the applicant; and he should in like manner be allowed to take depositions on his behalf: and any parties should be heard, who should desire to oppose the application. If the result should be a grant of the Patent, the patent so granted should be conclusive evidence of its own validity, and the only question to be thereafter tried, should be the question of infringement in fact. During the period between the application and the final decision and issue of the patent, the applicant should be at liberty to introduce his invention to public use, without waiving his right: and any person using it during that interval without the consent of the applicant, should (if the Patent were afterwards granted) be liable for the infringement in the same mode as for a similar use after the issue of the patent.

2. In lieu of the existing system of injunctions in Chancery, and actions for damages, I would impose as a penalty for infringement, a sum equal to ten times the sum to be paid for the liberty to use the patent: one-half of this penalty should go to the United States for the use of the patentee, and the other half to the party who should sue for the same or who should inform the patentee of the existence of the infringement. On payment of the penalty, the defendant should have a license to use the patent to the extent of the use for which the penalty had been imposed: but on judgment for the penalty, he should, as a matter of course, be (at the option of the patentee,) enjoined by a writ issued in the case itself, and founded on the judgment, and to be enforced by the usual attachments, &c., from using the patent until payment of the penalty, or new penalties should be recoverable for the subsequent use.

In actions for the penalties, it should be lawful for the Court on the application of either party to award a special venire facias, commanding the Marshal to return on the panel, a certain proportion at least, of persons of competent science and skill in the particular art to which the patent relates, and at least four of the skilled persons so returned, should sit as jurors in the trial.

3. At the time of reporting in favor of the issue of the patent, the examiners should also report a certain fixed sum to be paid to the patentee for the license to make, vend, or use the thing patented—if a machine: so much for each machine, to be so made, vended, or used:—if a process of manufacture: so much for any given quantity made by the process. The sum thus fixed, should be advertised with notice of the issuing of the patent: and any person paying that sum into the Patent Office for the use of the patentee, should receive a certificate which should be a license to the extent of the sum paid: and all persons engaged in making and vending the thing patented, or in manufacturing by a patented process, should be required from time to time, to report on oath, the extent of use by him, and deposit the sum due thereupon.

An account should be kept at the Patent Office of all sums so received for the use of the patentee, who should be entitled to receive the same at certain fixed intervals—say, quarterly, semi-annually, or annually, as might be thought most convenient, after deducting a per centage, say

five per cent. allowed to the Patent Office for defraying the expenses of collecting and keeping the account.

Proper provisions should be made for appeals by the applicant, or those opposing his application, from the decision of the first Board of Examiners, on the question of issuing the patent and on the sum to be paid for license to use it.

It appears to me that some such system as I have here roughly sketched, would, if properly digested, and carried out, relieve most of the existing embarrassments.

BIBLIOGRAPHICAL NOTICES.

"*The Gallery of Illustrious Americans.*" *Containing the Portraits and Biographical Sketches of* 24 *of the most eminent citizens of the Republic, since the death of Washington. New York: Brady, D'Avignon & Co., G. D. Putnam, D. Appleton & Co., C. S. Francis & Co.* 1850.

The work consists of a series of portraits, with biographical notices appended, intended to make us familiar with our own great men. The present number contains the portrait of Col. Fremont; how he gets there we cannot say, but will not at present stop to question his right. The portrait has the appearance of faithfulness, and is well lithographed and printed; but we are sorry that some friend with better taste had not been at the editor's elbow to induce him to adopt a more legible form of type. The execution is very good, but the form is exceedingly unreasonable and unpleasant. ED.

Elements of Natural Philosophy. By W. H. C. BARTLETT, LL. D., *Prof. Nat. & Exper. Philos. in the U. S. Military Academy at West Point. Sec. I.—Mechanics. New York: A. S. Barnes & Co.; Cincinnati: H. W. Derby & Co.* 1850.

In the last number of the Journal we acknowledged the receipt of a copy of the above work, and noticed favorably the mechanical execution of it, promising to take another opportunity, after a more careful examination of it, to express our opinion upon its scientific merits. We now return to the subject for the purpose of recommending its perusal to every one whose taste or interest leads him to desire a clear and accurate knowledge of the principles of which the work treats. The amount of valuable time and labor which are every year thrown away by ingenious men, by inventing useless and impossible apparatus, would scarcely be credited by any one whose business does not require him to examine the list of patented inventions, or to come into contact with inventors themselves. Even the perpetual motion, which has for so many centuries been the stumbling block of half educated men, is not yet done with, and the unfortunate man to whom such an invention is submitted, finds it impossible to convince its well meaning author of the futility of his scheme, because he has misunderstood some one of those axioms of mechanics which have been traditionally handed down in the language of past centuries, and which have now either no meaning at all, or one